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MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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THE QUARTERLY BULLETIN

The Quarterly Bulletin of the Michigan Agricultural Experiment Station is issued in February, May, August and November. It presents progress reports on long-term major research projects and final reports on short-term projects.

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THE QUARTERLY BULLETIN

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MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

L. M. TURK, DIRECTOR
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J. G. DUNCAN, EDITOR

PROGRESS IN MICHIGAN'S AGRICULTURE[1]

As Measured by Increased Crop Yields and Livestock Production Rates

By JOHN N. FERRIS and ELTON B. HILL
DEPARTMENT OF AGRICULTURAL ECONOMICS

MUCH PROGRESS in agricultural production has occurred during the last 25 to 40 years. Considerable information on such progress for the entire United States has been published, but little or none in respect to the gains made in Michigan.

This study was undertaken to determine the extent of the increased production of food by Michigan farmers. Yields per acre in crops, per tree in fruits, milk per cow, and eggs per hen were chosen as indicators for these respective farm enterprises.

Crop yields and livestock production rates were computed for a 10-year historical base period and for a recent 10-year period. For field crops, the average 1943-52 yields were compared with the averages for 1909-18. Fruit yields were determined for 1942-51 and for 1919-28. Production rates of milk cows and laying hens in 1942-51 were compared with those for 1925-34. The availability of basic data was the determining factor in the selection of the particular periods used in this study. For example, information on milk production per cow in Michigan by years was not reported previous to 1925.

The absolute increases in yields between these periods were computed and multiplied by the number of acres, trees, dairy cows or laying hens in a recent year (1950, 1951 or 1952). The resulting figures represent the total production increases due to higher yields or production rates.

For example, the average yield of corn was 30.5 bushels per acre in 1909-18 and 37.5 in 1943-52, an increase of 7.0 bushels. In 1952, Michigan farmers harvested a total of 1,672,000 acres of corn. Be-

[1]Acknowledgments: The authors wish to express their appreciation to C. J. Borum and F. R. Brush, of the Michigan Cooperative Crop Reporting Service, who assisted in compiling the statistics included in this study; and also to the many staff members who contributed material and helpful suggestions. Special recognition is due C. M. Harrison and H. R. Pettigrove, of Farm Crops; J. G. Lill, Agronomist, U. S. Department of Agriculture; L. M. Turk (now Director, Michigan Agricultural Experiment Station); R. L. Cook and R. M. Swenson, of Soil Science; E. W. Henderson and J. M. Moore, of Poultry Husbandry; H. D. Hootman, of Horticulture; Earl Weaver, N. P. Ralston, and J. G. Hays, of Dairy; E. A. Andrews, of Botany and Plant Pathology; and Ray Hutson, of Entomology.

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cause of increased corn yields, approximately 11,704,000 more bushels of corn were produced on the 1952 acreage (based on 1943-52 yields) than would have been possible if yields had not increased since 1909-18 (7.0 x 1,672,000 = 11,704,000).

FIELD CROPS

From 1909-18 to 1943-52, substantial increases in yields were obtained with most Michigan field crops. The acre yields of potatoes, beans and wheat increased by nearly 50 percent, while those of hay and corn registered more nominal increases. Yields of oats and, particularly, sugar beets did not change significantly (Table 1).

THE EFFECTS OF FERTILIZERS

The use of more and of higher analysis fertilizers must be credited for part of the increased crop yields. The amount of commercial fertilizer applied in Michigan has increased from 112,616 tons in 1920 to 574,766 tons for the crop year of 1951-52. The analysis has improved from an average grade of 2-12-6 to about 3-14-9 in the 1936-52 period. Michigan farmers have also achieved better response from fertilizer through band placement, side dressing and timely application. Increased use of lime has also contributed to higher yields.

BETTER SEED

Michigan farmers have benefited from better seed, particularly hybrid corn. Acres in hybrid corn in Michigan increased from 15 percent of the total corn acreage in 1937-41 to 80 percent in 1942-51. Disease-resistant strains of oats, wheat and barley have been developed and introduced.

Oat yields have not increased as much as have the yields of many of the other crops. Some reasons for this are 1) oats is the most widely grown crop in Michigan and is grown on all kinds of soils – good, fair and poor; 2) the newer varieties are more resistant to current oat diseases but probably are not greatly superior in yield when compared with the oat varieties commonly grown during the period 1909-18; and 3) oats is a relatively low value crop and does not receive the careful attention which is given to corn, wheat and some other higher income crops.

Hay yields have responded favorably to the introduction of new species, improved mixtures, increased use of fertilizer, use of legume

*TABLE 1—Increases in yields of principal Michigan field crops from 1909-18 to 1943-52**

Item	Hay, all	Potatoes	Corn, all	Beans, dry edible	Sugar beets	Wheat, winter	Oats	Barley
	ton	*bu.*	*bu.*	*lb.*	*ton*	*bu.*	*bu.*	*bu.*
Yield per acre:								
Ten-year average, 1909-18	1.2	93	30.5	625	8.8	17.3	33.8	25.4
Ten-year average, 1943-52	1.4	141	37.5	899	8.9	25.0	35.9	29.6
Increase in yield, total	0.2	48	7.0	274	0.1	7.7	2.1	4.2
Increase in yield, percent	16	52	23	44	1.1	45	6	16
Acres, 1952 (thousands)†	2,455	57	1,672	361	56	1,438	1,547	91
Production increase total in 1952 due to increase in yields, in thousands; (acres in 1952 x yield increase = total)	466	2,759	11,704	98,914	5.6	11,073	3,249	382

*Data not footnoted are from the records of the Michigan Agricultural Statistician, Federal Building, Lansing, Michigan.

†*Crop Production*, Annual Summary, 1952, Bureau of Agricultural Economics, U. S. Department of Agriculture.

inoculants, and better cultural practices. The alfalfa-brome combination has made two cuttings of hay per year more common in Michigan.

INSECT AND DISEASE CONTROL

New fungicides, insecticides and weed killers are now available and are being increasingly used to improve crop, fruit and vegetable yields. Farmers in the United States have increased their use of insecticides and fungicides by 260 percent since 1935-39. Fungicides which have made possible the higher crop, fruit and vegetable yields include bordeaux mixture (also applied extensively in 1909-18), "fixed" or "insoluble" copper, the elemental sulfurs, organic mercuries, and the organic sulfurs.

Insecticides which have been prominent in recent years are DDT, BHC, Chlordane, Parathion and TEPP. DDT has been particularly effective in increasing potato yields as have Parathion and TEPP in fruits.

Chemical weed killers, such as 2-4-D, have also been beneficial.

Farmers have reduced insect damage in wheat considerably by more general observance of the fly-free dates.

DRAINAGE AND MACHINERY

Tile drainage has increased the productivity on the heavier, wetter soils considerably during the last 30 or 40 years. Improved crop rotations have also aided certain crop yields, particularly potatoes.

More and better machinery has been made available to Michigan farmers. Inputs of power and machinery increased 76 percent from the period of 1935-39 to the year 1952 in the United States, and there is reason to believe that a similar increase occurred in Michigan. The effect of this technology on yields cannot be readily ascertained. New developments in machinery may have increased some yields by permitting more timely planting, cultivating and harvesting. Timely plowing has been of particular importance in inducing higher bean yields. Better spraying equipment has given more thorough coverage on both crops and fruits.

On the other hand, new machinery may have also had an adverse influence on yields. As machinery has permitted farmers to handle more land, less care may have been taken with each acre. For instance, corn planters are usually pulled along at a faster speed with a tractor than they once were with horses. Poorer stands often result. The better grading of seed corn, however, makes possible a better and more uniform seeding rate. Some types of machinery are inherently injurious to yields. Much corn is lost in the field by the shelling action of pickers. Compaction of the soil by heavy machinery may have tended to keep sugar beets and beans from making the gains in yields obtained with some other crops.

GROWING CROPS IN AREAS TO WHICH THEY ARE BEST ADAPTED

The production of potatoes, beans and beets have been concentrated in more favorable growing areas. This concentration is evidenced by a reduction in acreage in the less favorable producing areas, and/or an increase in acreage in the more favorable areas. Between 1909-18 and 1943-52, potato acreage was reduced by over 50 percent and sugar beet acreage by over 25 percent. This reduction was mainly in the counties less favorably suited to potato and beet production. Total bean acreage did not change significantly in this period, although a shift to more productive areas did occur.

SUGAR BEET YIELD INCREASES SMALL

Although beet production became concentrated in more favorably suited areas, beet yields did not increase. A principal reason has been the diminishing porosity of beet soil. Beets are very sensitive to a lack of adequate aeration. Because of more years of cropping, more intensive rotations, and the use of more and heavier equipment, the best soil has become compacted and aeration has been impaired. Many beet farmers have become more specialized, have raised fewer livestock, have grown less legumes, and thus have returned less organic matter to the soil. Mechanization has permitted more extensive operations, but yields may have suffered in some instances from less careful blocking, thinning and harvesting than was accomplished when the work was done by hand by experienced workers.

*TABLE 2—Years of noticeably low crop yields during the two base periods**

Crop	Period 1909-1918	Period 1943-1952
Hay, all tame	1918	....
Potatoes	1915, 1916	1947
Corn, all	1917	1946, 1947
Beans, dry, edible	1915, 1916, 1917	1944, 1947
Sugar beets	1909, 1912, 1916	1943, 1947
Wheat, winter	1912, 1918	1943
Oats	....	1943
Barley	1911	1943

*Crop yields were rather consistent for both base periods and were noticeably poor during only the years listed in this table.

DECREASED ACREAGE OF LAND IN CROPS

Since 1909-18 there has been a decrease of about 2,000,000 acres of crop land in Michigan. This decrease in crop land has probably been caused by two factors: 1) an increase in the urban and suburban use of land and 2) an abandonment of the poorer land either because of changes in economic conditions or by loss of its virgin fertility. What effect through this decrease in acreage of crop land in Michigan since 1908-18 may have had on crop yields is not known, but in all probability it is much less than might be anticipated. About the same proportional decreases in acreages of land have occurred in the southern part of the state as in the northern part.

APPLES, PEACHES AND CHERRIES

Phenomenal increases in yields have been registered in apples, peaches and cherries in the last 20 or 30 years. Most significant is the 164 percent increase in the per tree production of peaches from 1919-28 to 1942-51 (Table 3). The increase in yield per apple and cherry tree during this period has been about 50 percent.

One item which helps to explain these increases is the reduction in number of non-commercial orchards. Over one million trees in non-commercial orchards (all fruits) have been removed through organized state effort in the last 10 years.

Universal use and heavier application of nitrogen fertilizers, together with the adoption of better fertilizer practices and the sod-mulch system of culture, especially for apples, are major causes of the increased fruit yields. The development and use of insecticides (particularly DDT), fungicides and hormone sprays contributed to this improvement. DDT helped to control the codling moth in apples, and Parathion has proved to be an effective control for many other insects. Thinning sprays increased long-term average yields by preventing over- and under-production in successive years. "Stop-drop" sprays have helped to keep fruit on trees until picking time.

Improved mechanical equipment, particularly that for applying

*TABLE 3—Increases in yields of apples, peaches and cherries in Michigan from 1919-28 to 1942-51**

Item	Apples, all	Peaches	Cherries, all
	bu.	*bu.*	*lb.*
Yield per bearing tree:			
Ten-year average, 1919-28	1.42	0.40	27.6
Ten-year average, 1942-51	2.13†	1.05	42.8
Increase in yield, total	0.71	0.65	15.2
Increase in yield, percent	50	164	55
Number of trees of bearing age	(1950)‡ 3,351,000	(1951) 2,700,000	(1951) 3,114,000
Production increase in 1950 or 1951 due to increase in yields; (number of trees in 1950 or 1951 x increase in yield, total)	2,376,000	1,766,000	23,670

*The data not footnoted are from the records of the Michigan Agricultural Statistician, Federal Building, Lansing, Michigan.

†Yields for all apple production were unavailable for 1945-51 although "commercial" production yields were recorded for these years. Yields for 1945-51 of all apple production were interpolated by multiplying the average percent that all apple production yields were of commercial yields in the period 1935-44 times the commercial yields in each of the years, 1945-51.

‡United States Census of Agriculture, U. S. Department of Commerce, Bureau of Census, 1950, p. 17.

sprays and fertilizer, has made possible more timely spraying and more thorough coverage.

Apple and peach yields, particularly, were affected by improved varieties.

MILK COWS

Milk produced per cow on Michigan farms increased 13 percent during the 17-year period from 1925-34 to 1942-51 (see Table 4).

Better feeding practices were a very important factor in accounting for this rising trend. By 1942-51, Michigan farmers had doubled the production of alfalfa hay over the 1925-34 period and were, also, able to improve the quality of their roughage through better harvesting and storage techniques.

Scarcity of labor and attractive meat prices in the last 10 years have induced farmers to cull more of their lower producing cows.

Better breeding has also been responsible for higher production rates. Progeny testing of bulls, which started in 1935, has provided better selection on the basis of proofs and pedigree analysis. The programs of the national breed associations have changed in favor of information which would indicate inherited transmission instead of individual characteristics. Integration of extension work and that of breed associations, dairy herd improvement and artificial breeding associations have given impetus to better breeding. Artificial breeding has expanded rapidly in Michigan since 1943. By 1951, about 20 percent of the dairy cows in Michigan were being bred artificially. With the exception of the latter part of the 1942-51 period, however, the effect on increasing the total production of milk has not been great.

Milking machines and their improvements have directly and indirectly affected production rates. The direct influence has been through more uniform milking techniques. Indirectly, this mechanization has permitted larger scale operation, which has been associated with better breeding, feeding and other management practices.

The number of small and non-commercial herds has decreased. Census figures show that the average size of dairy herds on Michigan farms increased from 5.2 in 1920 to 7.5 in 1950. About 82 percent of the "total number of farms reporting" had milk cows in 1930, while only 68 percent were in this group in 1950.

Other factors relating to higher milk production rates in 1942-51 than in 1925-34 are disease control, improved housing and more favorable prices. Farmers fed their cows to near capacity to take advantage of particularly favorably milk-feed price ratios in 1942-51.

*TABLE 4—Increases in production rates of milk cows and laying hens on Michigan farms from 1925-34 to 1942-51**

Item	Milk cows, milk†	Laying hens, eggs‡
	lb.	*no.*
Production rate per cow or per layer:		
Ten-year average, 1925-34	5,122	130
Ten-year average, 1942-51	5,800	164
Increase in rate, total	678	34
Increase in rate, percent	13	26
Number of cows or layers§, 1951¶	854,000	8,799,000
Production increase in 1951 due to increase in production rates; (number of cows or layers, 1951 x increase in rate = total)	579,012,000	298,286,000

*Data not footnoted are from the records of the Michigan Agricultural Statistician, Post Office Building, Lansing, Michigan.

†Excludes milk sucked by calves and milk produced by cows not on farms.

‡Number of eggs produced during the year.

§The estimated number of cows during the year, heifers not freshened excluded; the average number of hens and pullets of laying age on hand during the year.

¶*Michigan Agricultural Statistics*, 1951, Michigan Department of Agriculture, Bureau of Agricultural Industry, May 1952.

LAYING HENS

The increase of 34 eggs per hen during the 17-year period from 1925-34 to 1942-51 is rather remarkable (Table 4). Better breeding is the most important reason for the increased rate of lay. Increases in white egg production have been through improvements in Single Comb White Leghorns and in brown egg production through improvements in Rhode Island Reds, Barred Rocks, New Hampshires and White Rocks.

The National Poultry Improvement Plan, which has been rather closely connected with the Michigan Cooperative Extension Service, has been instrumental in promoting and developing higher producing birds.

Improved feeding practices are considered to have been less effective than breeding in increasing egg production. The most important contribution of nutrition has been in reducing costs rather than increasing production rates. New vitamins and more complete protein supplements are making feeds more efficient. For example, poultrymen have been able to balance their feeding rations more cheaply because research has developed complete feeds, using protein supplements from the vegetable proteins which are now more readily available in quantity. This development has tended to hold down the price of other protein supplements.

Disease control cannot be overlooked as an important factor in the increased production rates. Indicative of the prevalence of the disease problem is the fact that the annual mortality rate in Michigan flocks was about 20 percent in 1942-51. This rate was higher in 1925-34. Progress has been achieved in reducing the incidence of pullorum disease, worms and coccidiosis (cecal type).

The value of management in egg-production gains is difficult to assess. The belief is held that better management, associated with greater specialization, has been an important contributing factor. An example of an improved management practice which has increased average rates of lay is the purchasing of healthier replacement stock.

A reduction in the number of small flocks has, in effect, raised the average production of laying stock. Census figures show that the average number of chickens 4 months old or over per farm raising chickens in Michigan increased from 71 in 1930 to 81 in 1950. In 1930, 86 percent of "total number of farms reporting" had chickens 4 months old and over. In 1950, the proportion represented by this group decreased to 67 percent.

INCREASES IN MAN LABOR EFFICIENCY

Although it is not the purpose of this report to document the gains in labor efficiency by Michigan farmers, yet some mention should be made of the remarkable changes that have occurred in some enterprises on which labor records are available.

DAIRY

Dairying is the most important farm enterprise in Michigan. In a southern Michigan study made in 1914 and 1915, the average number of man-hours spent per cow was 175. In a 5-year, 1932-36, similar study the average number of hours spent per cow was 154. In 1945, the number of hours spent per cow in southern Michigan was 132 and in 1951 the number was 95. Many farmers are caring for twice as many cows during the same time as did their fathers 40 years ago. Most of this improvement has come in the past 10 years.

TOTAL FARM

In a 1930 Farm Business Analysis Report for Type-of-Farming Area 5, the average accomplishment per man in terms of productive man-days of work was 255. Based on the same standards of performance

and for the same area in 1952, the average accomplishment was 375 per man. In other words, the efficiency of man labor on these farms had increased about 50 percent in the last 25 years. The total productive days work provided per farm increased from 419 in 1930 to 645 in 1952, or an increase of about 55 percent in size of the farm business.

The number of men on Area 5 farm-accounting farms remained about the same for both years. The amount of land per farm increased from 170 acres in 1930 to 243 acres in 1952, an increase of about 45 percent. Much of the increase in man-labor efficiency resulted from the use of larger power and machinery units which enabled one man to farm more land and to keep more livestock. The average machinery investment and the annual machinery expense were $1,486 and $388, respectively, for 1930 and $8,206 and $2,600, respectively, for 1952. Inasmuch as farm machinery prices have doubled since 1930 this would mean that the average farmer in 1952 had about 2¾ times more machinery than he had in 1930.

VALUE OF INCREASED YIELDS

The question is often asked, "What is the value of the increased production, due in large measure to the applications of science on the farm?" This is not an easy question to answer. Certain it is that both the farmer and the consumer benefit.

If one disregards the effect of the supply of a product on the price received, the gross value of the increased production since the base periods used in this study is now judged to be about $95 million a year in Michigan. The aggregate gross value of the increase in the major field crops is $64,000,000; for fruits, $11,000,000; for milk, $24,000,000, and for eggs, $11,000,000, making a gross total of $110 million. The $95 million figure was determined after recognizing some duplication, including the extra feed required for the increased production of milk and eggs.

At first glance, the $95 million would seem to be additional gross receipts for the producer. This would be true if an increased production had no effect on the price of the commodities. Commonly, however, an increase in the amount of a commodity supplied to the market will tend to lower the price of that commodity.

With an increasing population there is an increasing demand for farm products. Because of increased production, the consumer's food supply is assured and at a price lower than if the increased production had not occurred. Thus the consumer gains. The producer also gains

TABLE 5—Derivation of the values of production increases due to higher yields of the principal Michigan farm crops and higher rates in the production of milk and eggs, from a base period to 1951 or 1952

Commodity	Unit	Production increase due to increase in yields			Price per unit average*	Value of production increase due to yield increase		
		1909-18 to 1952	1919-28 to 1951	1925-34 to 1951	1943-52	1909-18 to 1952	1919-28 to 1951	1925-34 to 1951
		1,000	*1,000*	*1,000*	*dollars*	*$1,000*	*$1,000*	*$1,000*
Hay	tons	446	.....	.....	20.70	9,646	.....	.....
Potatoes	bu.	2,759	.....	.....	1.64	4,525	.....	.....
Corn	bu.	11,704	.....	.....	1.49	17,439	.....	.....
Beans	lb.	98,914	.....	.....	0.068	6,746	.....	.....
Wheat	bu.	11,073	.....	.....	2.03	22,478	.....	.....
Oats	bu.	3,249	.....	.....	0.78	2,534	.....	.....
Barley	bu.	382	.....	.....	1.19	455	.....	.....
Sugar beets	tons	5.6	.....	.....	12.28	69	.....	.....
Apples	bu.	.....	2,376	.....	1.63	.....	3,873	.....
Peaches	bu.	.....	1,766	.....	1.91	.....	3,373	.....
Cherries	tons	.....	23.67	.....	152†	.....	3,598	.....
Milk	lb.	.....	.....	579,012	0.042‡	.....	.....	24,318
Eggs	no.	.....	.....	298,286	0.038‡	.....	.....	11,216

**Michigan Price Reports*, Office of Michigan Agricultural Statistician, Post Office Building, Lansing, Michigan.

Michigan Agricultural Statistics, 1951, Michigan Department of Agriculture, Bureau of Agricultural Industry, May 1952.

Crop Report for Michigan, USDA, BAE and Michigan Department of Agricultural Industry.

†Composite price derived from the weighed average of the prices of sweet and red cherries.

‡1947-51 average price.

because much of the value of the increased production is reflected in increased receipts to him. It is also recognized, however, that the increased production requires additional costs in production, particularly in such items as fertilizers, spray materials, purchased feeds and machinery.

Wheat and corn in 1952 led the other field crops in respect to value of increased yields since 1909-18, principally because these crops have been more extensively grown and rank higher in total value than all other Michigan field crops except hay. Hay experienced a somewhat less percentage increase in yield, which amounted to an annual increase of nearly $10 million. Ranked below wheat, corn and hay in value of increased yields were beans, potatoes, oats, barley and sugar beets, respectively.

The values for one year of yield increments since 1919-28 in apple, peach and cherry production were about the same for each crop or $3.9 million, $3.4 million and $3.6 million, respectively.

One of the most valuable improvements in Michigan agriculture has been the increased production rate of milk cows. Since 1925-34 increased production rates (applied to the milk cow population of 1951) have become worth over $20 million per year. Egg production rates have also made noteworthy improvement, the 1951 rate being worth $11 million more than it would have been if hens had continued to lay at the average rate for the period 1925-34.

GROWTH STIMULANTS IN POULTRY FEEDING

By PHILIP J. SCHAIBLE
DEPARTMENT OF POULTRY HUSBANDRY

AS MORE AND MORE has been learned of the nutritional needs of poultry, certain aspects of the environment have been discovered to be of importance. Such factors as the degree of sanitation or contamination, "oldness" or "newness" of quarters, wire floors or solid floors with litter, and isolation have been found to influence growth response and feeding results. Providing continuously new facilities is, of course, not feasible. A more practical solution to this problem fortunately has been found – the addition of so-called growth stimulants to the diet which control the effects caused by environmental differences.

The discovery early in 1950 that certain medicinal chemicals added at very low levels to the diet stimulated early growth of chickens and turkeys opened up a new era in the science of animal feeding. These substances are not nutrients as are protein, carbohydrate, vitamins and minerals. They seem to stimulate growth by protecting newly-hatched, germ-free chicks or poults against the usual contamination, found where poultry have been kept previously, until they have adapted themselves to the new environment. While not an essential dietary requirement of poultry, these new substances prevent retarded early growth and, thus, make good starting feeds even better.

Two groups of such growth stimulants – antibiotics and arsenicals – are now used in commercial feeds. Another group of non-medicinal compounds, called surfactants, are alleged to have similar properties but so far have not been employed commercially.

ANTIBIOTICS

Antibiotics are produced by the fermentation industry during the controlled growth of specific molds, yeasts, or bacteria. As marketed to the feed industry, they are crude fractions of the so-called "wonder" drugs prescribed medicinally to fight human and animal diseases. It may seem paradoxical to employ substances that inhibit or destroy germs to stimulate growth of poultry. But, as will be explained later,

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their action is upon the microorganisms naturally present in the intestinal tract of apparently normal birds and, thus, only indirectly on the birds themselves.

Such antibiotics as penicillin, aureomycin, terramycin, bacitracin or streptomycin are marketed in suitable dilute pre-mixes for low-level feed usage. Some antibiotics act on just a few kinds of organisms (narrow spectrum) and others on larger numbers (wide spectrum). Combinations of different antibiotics in feeds do not seem to be more beneficial than do single ones.

Under favorable conditions, antibiotics promote more rapid early growth of birds by 5 to 15 percent, improve feed efficiency by 5 to 10 percent, slightly reduce early mortality, shorten the feeding time to broiler weight, improve coloring and feathering, and make the flock develop more uniformly. Antibiotics do not improve fertility, egg production, egg weight, hatchability, or the quality of hatched chicks.

The manner in which antibiotics act on the microorganisms in the intestines of apparently normal animals and improve nutrition is still somewhat of a mystery. For example, antibiotics do not change significantly the total number of germs in the intestine except for one kind (clostridia). They spare the requirements for protein, certain vitamins and minerals, make the intestine more acid, improve absorption, and stimulate bone growth. From an over-all point of view, antibiotics seem to give newly-hatched chicks partial protection while they are getting adjusted to their new environment. Antibiotics are not effective if the birds are grown in a germ-free environment or are housed in new quarters; a certain level of contamination is necessary for them to be beneficial.

Since antibiotics are of value only during the early growth of chickens and turkeys, their use is indicated in starting, growing and broiler feeds – not in egg or breeder mashes. If put in the latter mashes, however, they do no harm. By the time the birds are 20 weeks old, there is no significant weight difference between those fed feeds with antibiotics or those that did not get antibiotics. Their only advantage in respect to flock-replacement chickens, then, is to decrease mortality and to improve feed efficiency.

The amounts of antibiotics fed are only a small fraction of the levels used for the treatment of disease. Two grams of penicillin per ton of feed or 5 to 10 grams of the other antibiotics are recommended. Inasmuch as antibiotics do not accumulate in the tissues of birds and there is little or no carryover to the egg, no harmful results have been

obtained from their long-time usage. When added at levels under 50 grams per ton and if no claims for therapeutic value are made, the feeds are not considered medicated.

ARSENICALS

Certain arsenicals, more recently introduced in poultry feeds, are believed to function in about the same manner as antibiotics. They stimulate early growth, improve feed efficiency, reduce early mortality, deepen pigmentation, and give more sheen to feathers. Growth is stimulated over and above that produced by antibiotics. The arsenicals are compatible with vitamins and coccidiostatic drugs added to feeds.

Chemicals currently in use are arsanilic acid (para amino phenylarsonic acid) or its sodium salt and 3-nitro powder (3-nitro-4-hydroxyphenylarsonic acid). Small amounts, but larger ones than the antibiotics, are used in feeds – 90 grams of arsanilic acid per ton of feed or 45 grams of the 3-nitro powder. Arsenicals should be removed from the feed 5 days before slaughter according to U. S. Food and Drug Administration (FDA) regulations, during which time practically all the chemical is excreted. If used properly, the arsenic content of poultry meat is much less than the amount allowable by FDA for spray residues on fruits.

But care should be exercised in the feed usage of these substances. The ratio of the amount of arsenicals producing toxicity to that producing desirable results in poultry is fairly small – much smaller than in the case of antibiotics. Consequently, only feed manufacturers who can make the small additions with precision and who have safeguards for control should consider their use. They are not well suited for small feeders who mix their own feeds. In the feed mill during operations of weighing and mixing with feed, only simple precautions against swallowing and inhaling the arsenicals are required. Mixed with the feed, no precautions are necessary. The feeds are considered medicated by FDA.

SURFACTANTS

Surfactants are the active substances of ordinary household detergents. Claims have been made for them as growth stimulants. Although much work has been done with different surfactants in feeds, there is insufficient convincing evidence to merit their adoption. But there are many hundreds of these compounds yet to be examined before their potential value in feeds can be ascertained.

NOT A SUBSTITUTE FOR PROPER SANITATION

Antibiotics and arsenicals are already standard additions to certain commercial feeds. While their effect apparently depends upon a certain degree of contamination in the environment, these substances should not be considered substitutes for proper sanitation. Because there are yet to be evaluated thousands of chemicals and drugs which may affect in some way the microorganisms in the intestine and thus improve nutrition of poultry, it is expected that there will be much active research in this field in the near future.

SELECTED REFERENCES

ANTIBIOTICS

Groschke, A. C., and R. J. Evans (1950). Effect of antibiotics, synthetic vitamins, vitamin B_{12}, and an APF supplement on chick growth. Poultry Sci. 29:616-618.

Heuser, G. F., and L. C. Norris (1952). Some results of feeding antibiotics to chickens. Poultry Sci. 31:857-862.

Matterson, L. D., and E. P. Singsen (1951). A comparison of several antibiotics as growth stimulants in practical chick-starting rations. Conn. (Storrs) Agr. Expt. Sta. Bul. 275.

Stokstad, E. L. R., and T. H. Jukes (1950). Growth-promoting effect of aureomycin on turkey poults. Poultry Sci. 29:611-612.

ARSENICALS

Frost, Douglas V. (1953). Considerations on the safety of arsanilic acid for use in poultry feeds. Poultry Sci. 32:217-227.

Morehouse, N. F. (1949). Accelerated growth in chickens and turkeys produced by 3-nitro-4-hydroxyphenylarsonic acid. Poultry Sci. 28:375-384.

SURFACTANTS

Bird, H. R. (1952). Antibiotics, arsenicals and surfactants. Feedstuffs, Sept. 20, p. 60; Oct. 11, p. 18.

Ely, C. M., and Stuart Schott (1952). Surface active agents as growth stimulators in chick rations. Proc. Seventh Distillers Feed Conf., Cincinnati, O., pp. 72-84.

CONSERVATION PROGRESS AND PROBLEMS ON MICHIGAN[1] FRUIT FARMS

By C. R. HOGLUND[2]

Department of Agricultural Economics and U. S. Department of Agriculture

The fruit farmer is confronted with the problem of using the combination of production practices which will result in high yields of quality fruit and at the same time will conserve the soil. Some operators find it difficult to attain both goals. Recommendations for improved soil management provide for substantial increases in orchard sod, cover crops, mulching, contour farming, and other such practices. But application of some of these practices, particularly sod, may actually reduce the yields of fruit if management is poor or if supporting practices are not used. It has been demonstrated that clean cultivation in orchards leads to serious erosion and, eventually, to reduced fruit yields. The use of uncontrolled sod will reduce erosion losses to a minimum, but it may also result in greatly reduced yields of fruit, especially on droughty soils and soils of low fertility.

Few groups of farmers in the state face such serious soil-management problems as do fruit growers. Orchard sites, in which the climate is best adapted for fruit, are often those most subject to erosion from wind and water. About 50 percent of the land area in the St. Joseph River Soil Conservation District (northern Berrien County) was found to be subject to moderate or severe erosion.[3] Erosion and water control and the maintenance of soil fertility are major problems in Peninsula Township of the Grand Traverse Soil Conservation District.[4]

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[1]This is one phase of a study of soil conservation problems carried out by the Agricultural Economics, Farm Crops, Land and Water Conservation, and Soil Science Departments in cooperation with the Agricultural Research Service and the Soil Conservation Service of the U. S. Department of Agriculture.

[2]Agricultural Economist, Agricultural Research Service, U. S. Department of Agriculture, and the Michigan Agricultural Experiment Station. Philip A. Wright assisted in the field work on this study. The author wishes to express his appreciation for help in setting up the project and carrying out the study to the State and District personnel of the Soil Conservation Service, the Cooperative Extension Service, several members of the Agricultural Economics, Farm Crops and Soil Science Departments; and the Agricultural Research Service of the U. S. Department of Agriculture.

[3]A progress report, "Study of the Potential Effect of Farm Conservation Planning on Land Use in Southern Michigan," by John S. McVicker. A project of the Land and Water Conservation Department, Michigan State College.

[4]Agricultural Resource Conservation Program of Grand Traverse County (a preliminary report).

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Fig. 1. Contour planting is an important conservation practice on many fruit farms.

A study was made in 1952 of the conservation problems and the progress in establishing conservation practices on 46 typical fruit farms in the Grand Traverse and St. Joseph River Soil Conservation Districts. An additional purpose of the study was to determine methods that could be used in overcoming obstacles that prevent widespread adoption of improved soil conservation practices.

CHARACTERISTICS OF THE FRUIT FARM STUDIED

ACRES IN FRUIT AND TRUCK CROPS

Fruit growers in the two districts operated about the same acreage of land but differed markedly as to the fruit and truck crops they grew. Cherries were the major crop produced on the Grand Traverse District farms, making up 82 percent of the acreage (Table 1). Apples accounted for most of the rest of the acreage. Peaches, pears and plums were produced only to a limited extent. In the St. Joseph River District, 71 percent was in tree fruits, 15 percent in small fruits, and

TABLE 1—Average acres of fruit and truck crops on the Grand Traverse and St. Joseph River District farms, 1952 and pre-plan

	Grand Traverse		St. Joseph River	
	1952	1945-47	1952	1945-47
	acres	*acres*	*acres*	*acres*
Tree fruits				
Apples	6.5	9.3	10.4	12.1
Cherries	44.6	29.3	4.4	3.6
Peaches	.5	.6	12.6	13.7
Pears	.8	.5	3.4	3.2
Plums	2.0	.6	1.3	.8
Grapes	....	....	3.1	2.7
Total	54.4	40.3	35.2	36.1
Small fruits				
Strawberries	....	....	2.8	3.6
Raspberries	....	....	3.9	1.6
Other	....	....	.9	.8
Total	....	....	7.6	6.0
Truck crops	....	....	6.8	3.7

14 percent in truck crops. Apples and peaches were major tree fruits. Cherries, pears, plums, and grapes were grown to a lesser extent. Strawberries and raspberries were the chief small fruits, while asparagus and tomatoes were the important truck crops produced in the St. Joseph River District.

The cherry acreage was increased by about 50 percent and the apple acreage reduced by 30 percent in the Grand Traverse District from 1945-47 to 1952. In the St. Joseph River District there were no major changes in the tree fruits grown, but the acreages of raspberries and truck crops were doubled.

FERTILIZER APPLICATION

More than 90 per cent of the acreages of the major fruit of bearing age and truck crops were fertilized. Fertilizer was applied on almost the entire acreage of cherries, peaches, and tomatoes in the St. Joseph River District. Less than 80 percent of the apple acreage in Grand Traverse District and the grape acreage in St. Joseph River District was fertilized. A few growers used no fertilizer.

Fertilizer was applied at slightly higher rates on the apple and cherry acreage in the St. Joseph River District than in the Grand Trav-

erse District (Table 2). Of the tree fruits, peaches received the highest application of fertilizer. Barnyard manure, in addition to commercial fertilizer, was applied on a few farms. Seven fruit growers in the Grand Traverse District applied an average of 11 tons of duck manure on an average of 14 acres of cherries in 1952. A few growers kept a few head of dairy or beef cattle for the major purpose of producing manure. However, most of the fruit growers in both districts had little or no livestock on their farms.

TABLE 2—Percentage of fruit and truck crops fertilized, and quantity of commercial fertilizer applied per acre fertilized, 1952

Crop	Percentage of acreage fertilized*		Quantity applied per acre fertilized*	
	Grand Traverse	St. Joseph River	Grand Traverse	St. Joseph River
	percent	*percent*	*pounds*	*pounds*
Apples	74	91	406	421
Cherries	91	98	550	687
Peaches	..	95	...	729
Grapes	..	77	...	442
Asparagus	..	92	...	1,042
Tomatoes	..	100	...	716

*Based on acreage of bearing orchards. A few growers used no fertilizer on their tree fruits.

TABLE 3—Percentage of cherry acreage on which fertilizers of different analyses were applied in 1952, Grand Traverse District

Fertilizer analyses	Percentage of acreage fertilized	
	First application	Second application
	percent	*percent*
Ammonium nitrate or sulfate	27	10
0-12-12	9	..
0-20-20	3	6
6-12-12	6	..
8-8-8	12	..
9-9-9	14	12
10-10-10	20	4
12-6-4	..	11
	91	43

Fruit growers in both districts used several different analyses of fertilizer on their crops. Fertilizers having eight different analyses were applied to the cherry trees in the Grand Traverse District (Table 3). Ammonium nitrate and sulfate and 10-10-10 were the most widely used fertilizers. Less than half of the cherry acreage received a second application of fertilizer in 1952.

PROGRESS IN APPLYING PRACTICES

THE FARM PLAN

A conservation plan had been prepared by district personnel for each fruit grower at the time he started cooperating in the soil conservation district program. About 75 percent of the cooperators in each district stated that the farm plans developed for their individual farms were workable (Table 4). That does not mean that this high percentage of fruit growers followed the plans completely. Progress in applying component parts of the plans varied greatly from farm to farm. Some growers had adopted all of the recommended practices, while others had made little or no use of their farm plans.

Various reasons were given for the plans not being workable on the other 25 percent of the farms. From 10 to 13 percent, or about one-half of these fruit growers in the two districts, considered the plans not workable, and felt that they called for too drastic changes. The changes involved contouring, rearrangement of field boundaries and use of sod in the orchards. Seemingly some of the fruit growers did

TABLE 4—Response of District Cooperators to questions on workability and usefulness of farm plans

Question	Percentage of farmers answering yes:	
	Grand Traverse	St. Joseph River
	percent	*percent*
Is plan workable?	75	77
If not workable, why?		
Too drastic changes	13	10
No help at all	12	13
Do you now make use of:		
Capability map?	38	53
Field arrangement map?	44	37

not recognize the need for these "drastic" changes, which were more or less dictated by the land situation. About one in each eight farmers in the two districts stated that the plan had been of no help to them. Some of these fruit growers felt that the plan called for no change in what they were already doing. Others had made little or no effort to follow the plan because they did not understand it or because it did not fit in with their own ideas of farming. Only about 10 percent of the fruit growers were in this latter group.

From one-third to one-half of the district cooperators were still using the land use capability maps and the field arrangement maps which were a part of the farm plan (Table 4). Many of those not now using these maps stated they had used them considerably in the first year or two but that they no longer needed to refer to them. A few farmers felt that the field arrangement map was not worth the time required to prepare it because orchard plantings were continually changed. Others believed the field map had been very helpful.

IMPORTANT CONSERVATION PRACTICES

The use of cover crops was practiced by the majority of fruit growers (Table 5). The acreage of cover crops had more than tripled from the time the farms had been planned for soil improvement and water control. The fruit growers were generally enthusiastic about the use of cover crops. A high percentage of them indicated that this was a major change from the clean cultivation previously practiced.

Sod in orchards was a practice used on less than one-half of the fruit farms studied. A higher percentage of the tree fruit acreage was

TABLE 5—Percentage of fruit acreage on which recommended soil management practices were applied, 1952

Practice	Percentage of acreage on which practice applied	
	Grand Traverse	St. Joseph River
	percent	*percent*
Cover crops	73	62
Orchard sod	21	30
Contour orchards	8	8
Mulching	6	13
Sod buffer strips	3	7
Alternate middles	2	2

Fig. 2. The shift from clean cultivation to the use of orchard sod and cover crops has been one of the most significant changes on fruit farms.

in sod in the St. Joseph River District than in the Grand Traverse District, largely because sod was used to a greater extent on apple and peach than in cherry orchards.

Not many fruit growers were enthusiastic about orchard sod. However, a high percentage of them believed that sod had a place in the orchards if they learned how to handle it. They expressed a need for more information on methods and machinery needed to utilize sod effectively. This was one of the most misunderstood practices recommended. Many growers stated that fescue sod had been unsatisfactory under the system of management they used. Such a sod was difficult to keep under control and, consequently, resulted in reduced yields of fruit. Some growers failed to use extra nitrogen when sod was used.

Planting orchards on the contour was followed on one out of every 12 acres in both districts (Table 5). New orchards on some farms were to be planted on the contour when old orchards were removed. Very few of the growers who had planted trees on the contour were as yet entirely satisfied with this practice. They experienced difficulty in spraying and performing other operations on the contours. However,

80 percent of the fruit growers who had planted at least part of their acreage on the contour believed it was a profitable practice. A few growers believed that orchards planted in straight rows across the slope were just as effective in controlling erosion and were much easier to operate.

Mulching of trees is a practice recommended on many fruit farms. Mulching was practiced on twice as great an acreage in the St. Joseph River District as in the Grand Traverse District. However, the practice was not used extensively in either district.

Sod buffer strips and alternate middles were two practices used to only a limited extent in both districts. Fruit growers who followed these practices were generally quite enthusiastic about their effectiveness in controlling erosion. Data from the Benton Harbor project runoff plots show the effectiveness of sod buffer strips.

INCREASING EFFECTIVENESS OF CONSERVATION PROGRAMS

HOW DISTRICT PROGRAMS HAVE BEEN MOST HELPFUL

Almost two-thirds of the cooperators rated technical assistance as the most beneficial help they had received from their districts (Table 6). These fruit growers received help in applying improved soil management practices, in setting up contour orchards and diversion channels and terraces and in laying out new field boundaries.

About a third of the growers rated information on their soils as being of most help to them. This information, together with soil tests,

TABLE 6—Farmers' opinions on how soil conservation districts have been most helpful to them

Item	Percentage of farmers reporting method of help	
	Grand Traverse	St. Joseph River
	percent	*percent*
Technical aid (contouring etc.)	67	60
Information on soils	33	36
Information on fruit practices	20	24

provided a basis for use of fertilizer, manure, and supplementary erosion practices. A somewhat smaller percentage of the growers stated that information on fruit practices had been most useful to them.

PROVIDING FRUIT GROWERS GREATER ASSISTANCE

If soil improvement and water control practices are to be applied to a greater extent in fruit areas, it will be necessary to overcome some major obstacles. The cooperators in the two districts suggested several aids which they felt would speed up adoption of erosion control practices. More than a third of these fruit growers emphasized the fact that more information was needed as to costs and benefits of practices (Table 7). They cited a need for more research on methods of managing sod, on improved cover crops, and on improved implements for use in controlling sod and for trashy cultivation. A few growers stated that their own delay in adopting recommended erosion control practices was due to a lack of knowledge of the effects of these practices on fruit yields, costs, and returns. More technical assistance and more community meetings were rated as important aids by about 10 percent of the cooperators. Almost half of the cooperators stated that sufficient information and technical assistance are available if farmers would take advantage of them.

TABLE 7—Farmers' choice of aids which they believed would speed up adoption of a conservation system of farming

Aid	Percentage of farmers who answered yes: Grand Traverse and St. Joseph River
	percent
More information on costs and benefits of practices	37
More technical assistance and follow-ups	9
More community meetings	10
No additional aids needed	46

RESULTS OF THINNING A SPRUCE - FIR STAND

By MAURICE W. DAY
DUNBAR FOREST EXPERIMENT STATION

A SERIES OF THINNING PLOTS, one-fifth acre in size each, was established in 1940 in a 30-year-old spruce-fir stand at the Dunbar Forest Experiment Station for the purpose of determining the response to different degrees of thinning. Re-measurements have now been made at 5 and 10 years after thinning, and the results indicate the value of the treatments. Since the plots were not replicated, the results do not lend themselves to statistical analysis, but it is believed that the study supplies some valuable information on the growth possibilities of these species.

The stocking, basal area, and average diameter of the trees of the four plots before any treatment are shown in Table 1. All four plots were located adjacent to one another upon an upland site, the soil type having been described as Munising stony sandy loam.

Three plots were thinned to spacings of 6 x 6, 8 x 8 and 10 x 10 feet or actually to 1,210, 680, and 440 trees per acre. Cutting was done in December 1940. The trees cut were utilized for Christmas trees as far as possible, and the rest of the slash was left on the ground. No pulpwood was produced at the time of cutting since most of the trees were of unmerchantable size, and the number of larger trees did not justify salvaging for pulpwood. The net cost of the thinning was about $20

TABLE 1—Stocking and average stand diameter before treatment, 1940

Plot number	No. of trees per acre	Basal area in Sq. Ft.* per acre	Average diameter, inches
1	2,910	103	2.6
2	1,940	107	3.2
3	2,320	121	3.1
4	2,210	105	2.9

*All trees.

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TABLE 2—Stocking, volume and average stand diameter after treatment, 1940

Plot number	Spacing	Basal area in Sq. Ft.* per acre	Merchantable volume† in Cu. Ft. per acre	Cords	Average diameter, inches	Stand density index
1	6 x 6	54	30	0.4	2.9	167
2	10 x 10	38	110	1.4	4.0	101
3	8 x 8	61	320	4.1	4.1	161
4	Control	105	310	4.0	2.9	305

*All trees.
†Trees 5 inches or more diameter breast high only.

TABLE 3—Stocking, volume and average stand diameter 5 years after treatment, 1945

Plot number	Spacing	Basal area in Sq. Ft. per acre	Merchantable volume in Cu. Ft. per acre	Cords	Average diameter, inches	Stand density index
1	6 x 6	94	310	4.0	3.8	252
2	10 x 10	67	540	6.9	5.35	158
3	8 x 8	97	950	12.2	5.2	232
4	Control	145	790	10.1	3.6	395

per acre. Data on the condition of the three thinned plots after cutting and that of the control plot are shown in Table 2.

In 1945 the first re-measurement of these plots was made; data on their condition at that time are given in Table 3.

In 1950 the second re-measurement was made; the results are summarized in Table 4. A comparison of Tables 2, 3, and 4 shows quite plainly the development of the four plots during the past 10 years.

The most pertinent matter is the rate of growth following thinning. The growth data, which are summarized in Table 5, are indicative of the effect of the three intensities of thinning upon the growth of the residual stand. The growth rate for all plots is impressive, especially so since a large proportion of the stand is still too small to be merchantable and is not included in the growth computations. Only trees in the 5-inch diameter class and larger were considered merchantable and were included in the growth data.

Thinning to a spacing of 6 x 6 on Plot 1 seems to have been inadequate. The growth on this plot has been less than on the other plots, including the control plot. However, part of this poor showing can be attributed to the low residual volume on this plot following thinning, in comparison with residual volume on the other thinned plots.

Growth on the plot thinned to a 10 x 10 spacing was greater than on Plot 1, but the thinning may have been somewhat heavy. It is doubtful that the residual stand of 440 trees per acre, aggregating only 38 square feet of basal area, has utilized the site fully during the 10-year period following thinning.

The best growth was obtained on Plot 3, with a spacing of 8 x 8. Satisfactory growth following thinning to this spacing can be expected in similar spruce-fir stands in this area.

Growth on the control plot has remained relatively high in comparison with that on the thinned plots. However, it is pertinent to point out that growth on the control plot was practically the same during both 5-year periods, while on the thinned plots growth during the second 5-year period averaged approximately one and one-half times

TABLE 4—Stocking, volume and average stand diameter 10 years after treatment, 1950

Plot number	Spacing	Basal area in Sq. Ft. per acre	Merchantable volume in Cu. Ft. per acre	Cords	Average diameter, inches	Stand density index
1.....	6 x 6	126	750	9.6	4.71	347
2.....	10 x 10	93	1,160	14.9	5.76	177
3.....	8 x 8	133	1,820	23.3	5.47	247
4.....	Control	164	1,280	16.4	3.89	374

TABLE 5—Volume growth by 5- and 10-year periods

Plot number	Spacing	1940-45			1945-50			1940-50		
		Cubic feet	Cords	Cords per acre per year	Cubic feet	Cords	Cords per acre per year	Cubic feet	Cords	Cords per acre per year
1.....	6 x 6	280	3.6	0.7	440	5.6	1.12	720	9.2	0.9
2.....	10 x 10	430	5.5	1.1	620	7.9	1.59	1,050	13.4	1.3
3.....	8 x 8	630	8.1	1.6	870	11.2	2.24	1,500	19.2	1.9
4.....	Control	480	6.2	1.2	490	6.3	1.25	970	12.4	1.2

TABLE 6—Standard deviation of average stand diameter

Plot number	Spacing	1940	1945	1950
1	6 x 6	±4.77	±5.25	±4.92
2	10 x 10	±2.71	±3.01	±4.98
3	8 x 8	±3.92	±3.98	±5.14
4	Control	±8.64	±10.36	±7.40

that obtained during the first 5-year period (Table 5). Thus, the thinning has had considerable effect in terms of increasing the growth of the stands.

The standard deviation of the average stand diameter is a measure of the dispersion of diameters in a stand, and can be considered indicative of the expression of dominance achieved in that stand. The greater the range of diameters, the larger the standard deviation of the average diameter will be, and the greater has been the expression of dominance.

Table 6 lists the standard deviations of the average stand diameters for each plot. The data indicate further beneficial effects of two of the thinning treatments. On Plots 2 and 3, the expression of dominance has been increasing during both 5-year periods, while on Plots 1 and 4 it increased during the first 5-year period, and then decreased substantially during the second period, especially on the control plot. Again, inadequate thinning on Plot 1 is indicated, and there is severe competition for growing space on the control plot.

Since stand density varies so widely between the plots, it is interesting to compare it with some standard. If the spacing is expressed in terms of percent of height, as advocated by Wilson[1], in 1950 the stand densities of the plots are as follows: Plot 1 — 17 percent, Plot 2 — 26, Plot 3 — 20 and Plot 4 — 14 percent. Thus it seems that plots 1 and 4 are too dense, plot 2 is too open, and plot 3 is at about optimum density. Likewise, if the stand density index (Reineke[2]) is used, and if one assumes an index of 300 to be about correct the plots fall into the same relationship to each other.

Total growth of the 8 x 8 spaced plot is computed at 19.2 cords, while that of the control plot is 12.4 cords, an advantage of 6.8 cords at only 10 years after thinning. If plot 1 had been the control and had its growth equalled that of the 6 x 6 spacing, 9.2 cords, the advantage of the 8 x 8 spacing would appear as 10.0 cords. If one uses the 6.8-cord

[1]Wilson, F. G. (1951). Control of growing stock in even-aged stands of conifers. Jour. For. 49: 692-695.

[2]Reineke, L. H. (1933). Perfecting a stand density index for even-aged stands. Jour. Agr. Res. 46: 627-638.

advantage of plot 3 over plot 4 and assumes a stumpage value of $8.00 per cord, he obtains a gross increase in value of $54.40 per acre in 10 years. If this is discounted at a 3-percent interest rate, a value of $40.48 at the time of thinning is derived.

It would seem, then, that up to that amount could be profitably spent on thinning similar stands of this species and value. At the least, it indicates that spruce-fir stands do respond to thinning and some investment in such thinnings may well be worth while.

The high stumpage value of these stands ($186.40 per acre on plot 3) makes any increase in growth rate highly desirable.

It is a matter of interest that several individual trees in plots 2 and 3 have grown more than 3 inches in diameter in 10 years. The maximum by species was: white spruce from 5.7 to 10.1 inches, balsam fir from 4.0 to 7.1 inches and black spruce from 5.1 to 7.9 inches.

The present plan on these plots is for another thinning in 1955 at age 45 and the first harvest cut at age 60. It is hoped to regenerate the stand in 10 years or less through the use of a shelterwood cutting system. It is the author's belief that at least some of the plots will show a mean annual growth for the 60-year period of ⅔ cord per acre each year. With an assured market at good prices for pulpwood of these species, the attractiveness of this return is self evident.

COMPARATIVE RESISTANCE TO LEAF BLIGHT DISEASES IN SOME COMMERCIAL VARIETIES OF CELERY IN 1952 AND 1953[1]

By RAY NELSON and MARIE MOOAR
DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

THE CONTROL of leaf diseases is a major problem in the commercial production of celery in Michigan. These diseases are a potential menace to crops each season, and protective control measures by applications of sprays or dusts must be a regular part of the cultural program if destructive outbreaks of leaf blights are to be avoided. Protection by dusts or sprays is an investment in crop insurance since other methods of control have not yet been developed.

Two leaf spot diseases are economically important in Michigan. Early blight, caused by *Cercospora apii*, attacks all above-ground portions of the plant. The lesions are round, elongated or irregular, brown and may attain a size of ¼ inch or larger. On the stalks, the lesions are elongated and sunken, and develop mostly between the ribs or veins. When temperature and moisture conditions are favorable, the causal fungus produces large numbers of spores on the surface of the lesions. High humidity and relatively high air temperatures are required for sporulation. The spores are air borne and are widely disseminated to other plants and fields by winds of low velocity. Conditions most favorable for infection of celery include the presence of moisture on the leaf for several consecutive hours and relatively high air temperatures. Bright, sunshiny days and warm nights with deposits of dew on the celery leaves are the most favorable environmental conditions for an outbreak of Cercospora leaf blight. The disease may develop rapidly in July, hence the name "Early Blight", or it may appear much later in the season when temperatures, moisture and other factors are more favorable. The disease is essentially a warm weather blight, and the most serious outbreaks are associated with seasons when mean temperatures are above normal.

[1]Contribution 54-2, Department of Botany and Plant Pathology, Michigan State College.

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The form of the late blight disease commonly seen in Michigan is caused by *Septoria apii graveolentis*. In contrast to Early Blight, it develops most seriously in wet and cool seasons. It attacks all aboveground portions of the plant. The spots are comparatively small, somewhat greasy in appearance, brown with conspicuous black specks developing in the centers of the lesions. The black specks are the fruiting structures of the causal fungus. They consist of flask-shaped structures inside of which gelatinous masses of spores are produced in great numbers. When the leaf is wet from rain or irrigation water, the spores ooze to the surface of the lesion and are splashed by drops of water to other leaves and to plants which are wet by the drops of water containing the spores. Late blight is typically a wet weather disease and may spread very rapidly in rainy weather. It is usually of minor importance in hot and dry seasons, such as in 1953.

Since both early and late blight lesions develop on leaf stalks and petioles, failure to control these diseases results in subsequent heavy trimming of the plants to remove the infected parts. Both leaf blight diseases are controlled by thorough and timely applications of suitable copper fungicides as dusts or sprays by Dithane or Parzate sprays or dusts and by others of the newer fungicides.

The most important soil-borne disease of celery is Fusarium yellows, and its control has been achieved by the development of resistant varieties. Cornell 19, Cornell 619 and Michigan Golden are important resistant varieties of Golden Self-blanching celery. Some strains of Utah Pascal, Earligreen and Emerson Pascal are among the green celeries resistant to yellows, and Emerson Pascal is also moderately resistant to leaf blight diseases.

In the breeding program for resistance to Fusarium yellows, tests have been conducted with various selections, hybrids and commercial varieties of celery to determine their comparative resistance to the leaf blight diseases. Resistance to yellows and desirable commercial quality are the chief objectives of the breeding work, but it is desirable to supplement these with resistance to leaf blights. Resistance to leaf diseases is lacking in most of the commercial varieties. Tests with wild species and varieties of *Apium* obtained from the Plant Introduction Station[2] have revealed inherent resistance to leaf diseases, and especially to Early Blight. Where possible these plants have been used in crosses with Fusarium-resistant lines to obtain resistance to leaf diseases which is now lacking in some of the best hybrid materials. The

[2]Beltsville, Md.

wild species and varieties of *Apium* are very undesirable commercial types. They are coarse-growing plants, very pithy, with a bitter or soapy flavor, and some are susceptible to Fusarium yellows.

MATERIALS AND METHODS

A planting to test for blight resistance in commercial varieties of celery was made in 1951, but the information obtained was less complete than the records from the 1952 and 1953 tests. The varieties planted in 1952 and 1953 were those now grown for commercial production of both yellow and green celery in Michigan or recommended for trial plantings to determine their adaptability for commercial culture in various sections of the state. The seed for these plantings was obtained from several commercial seedsmen or if not available from these sources a sample was requested from the originators. Cornell 619 was obtained from Cornell University.

In 1952 the seed of the commercial varieties and of the various hybrids and selections was sprouted in steamed soil, and the soil and sprouting seed were placed in a cold frame in early May. The soil in this frame had been treated in 1951 to control weeds and damping-off. The seedlings were transplanted to the field about June 26. They were not dusted or sprayed in the seedbed, and no blight protection was given them during the growing season. At the time of transplanting they showed much root injury, apparently from the soil fumigation and insufficient leaching to remove harmful materials released in the soil. Because of drought conditions and root injury the plants did not grow normally and attain full development up to the time of harvest in September. Complete blight resistance records, however, could be taken.

In 1953 a similar planting was made in steamed soil in flats, and the seedlings were grown in the greenhouse until time for planting in the field on June 26. No seed treatment was used either in 1952 or 1953, and the seedlings were not dusted in the seedbed or in the flats. Early blight developed in some of the most susceptible hybrids and varieties while they were growing in the seed flats. The source of the inoculum was apparently the seed or infected stock plants which were overwintered in a cold frame attached to the greenhouse. In the fields used for the blight resistance ratings in both 1952 and 1953 the inoculum potential was sufficiently high to assure infection by either *Cercospora* or *Septoria*. It was especially high for *Cercospora* in both seasons. Celery has been planted in these fields in uninterrupted sequence for

many years, and one or both leaf blights develop when seasonal conditions are favorable for their occurrence. All weeding was done with hand cultivators or hoes, and because of the extreme drought conditions it was necessary to irrigate with water from wells to keep the plants growing and to prevent wilting. A complete fertilizer was broadcast and raked into the soil prior to planting, and a side dressing of ammonium nitrate was used as a source of nitrogen in August. To correct deficiency symptoms which were apparent in the foliage by August, the plants were sprayed twice with a solution of manganese sulfate and magnesium sulfate, 3 pounds and 10 pounds per 100 gallons, respectively. The solutions were applied with knapsack sprayers.

In 1952 the commercial varieties of celery in the test plots became infected with *Cercospora apii* and *Septoria apii graveolentis*, and it was possible to make resistance readings in September. In 1953, because of extreme drought conditions from June through September, no late blight infections were observed in the test plants. The precipitation deficiency exceeded 6 inches for the months of June, July and August. Early Blight caused severe injury in the most susceptible varieties in the test planting, but it was kept under good commercial control where other plantings for marketing were protected with applications of dust or spray.

To record readings for resistance to leaf blights an arbitrary infection scale of 0 to 5 was used in 1952 and 1953. A reading of 0 indicates no blight infections, 1 scattered infections on the outer leaves, and a reading of 5 shows that the plants were severely injured by the disease, with the outer leaves having been killed by blight. The final readings were made in late August and mid-September after the commercial plantings of celery had been harvested. The comparative resistance ratings are shown in Table 1. The variety Utah 10-B was not used in 1953 because of its marked susceptibility to magnesium deficiency and to Brown Blight (*Cephalosporium*), which has not been controlled by either sprays or dusts.

RESULTS

The results recorded in Table 1 demonstrate the general susceptibility of most commercial varieties to Early Blight when seasonal conditions are very favorable for the development of the disease. There was considerable variation in resistance among the 24 varieties tested and also in the reactions of these varieties in the two seasons of 1952 and 1953. Florida Green Pascal, Emerson Pascal, Improved California Pascal and Earligreen showed more resistance to leaf blights than most

TABLE 1—Comparative resistance to leaf blights in commercial celery varieties in 1952 and 1953*

Variety	Seed source	1952		1953
		Early blight	Late blight	Early blight
Earligreen	Ferry-Morse	2	1	4
Utah 10-B	Ferry-Morse	4	3	no reading
Summer Pascal	Ferry-Morse	3	3	2
Sweetheart	Ferry-Morse	3	2	3
Utah 15	Ferry-Morse	4	4	4
Cornell 19	Ferry-Morse	3	5	5
Utah 15	Grand Rapids Growers	5	5	4
Improved California Pascal	Grand Rapids Growers	3	3	2
Superior Pascal	Grand Rapids Growers	4	4	5
Grower's Pascal No. 49	Grand Rapids Growers	4	3	4
Grower's Earligreen	Grand Rapids Growers	3	3	4
Paragon	Grand Rapids Growers	4	2	3
New Golden Self-blanching	Grand Rapids Growers	4	4	5
New Golden Plume	Grand Rapids Growers	5	5	5
Utah 52-70	Grand Rapids Growers	3	5	5
Utah 52 10-B	Grand Rapids Growers	4	1	no reading
Cornell No. 6	Grand Rapids Growers	5	5	5
Emerson Pascal	Grand Rapids Growers	3	1	3
Grower's Wonderful	Grand Rapids Growers	4	4	5
Jersey Golden Plume	Grand Rapids Growers	4	4	5
Utah No. 6	Gunson & Co.	5	5	5
Pascal Superb	Keystone-Corneli Seed Co.	5	2	5
Tall Fordhook	Eastern States Farmers' Exchange	3	3	5
Florida Green Pascal	Associated Seed Growers	2	0	3
Utah 16	Associated Seed Growers	4	4	5
Cornell 619	Cornell University	4	4	not grown
Michigan State Green-Gold-Commercial 1949 seed		3	3	4
Michigan Golden	Mich. State College 1949 Seed	—	—	2

*0—No blight.
1—Scattered infections on outer leaves.
5—Severe injury, outer leaves killed.

of the other green varieties. Summer Pascal and Sweetheart could be rated as moderately susceptible to leaf blights as a result of the two-year test. Florida Green Pascal, Utah 10-B, Emerson Pascal and Earligreen were most resistant to Late Blight in 1952, but no readings were obtained in the 1953 tests.

Among the Golden Self-blanching celeries, New Golden Self-blanching, New Golden Plume, and the Cornell varieties were very susceptible to leaf blights in both seasons. Cornell 19 was severely attacked by Early Blight in 1953, but Michigan Golden was only slightly injured in the same planting. All varieties, green and yellow, are sufficiently susceptible to Early Blight to require protection with fungicides in seasons such as 1953.

THE EFFECT OF HARVESTING CONDITIONS ON MOLD COUNT OF BLACK RASPBERRIES

By K. L. NARASIMHAM, C. L. BEDFORD and W. F. ROBERTSON

DEPARTMENT OF HORTICULTURE

FOR THE PAST SEVERAL YEARS considerable difficulty has been experienced by commercial canners with mold in canned black raspberries. Preliminary experimental tests indicated that molds grow on or in black raspberries in the field and that they cannot be eliminated by the farmer. Consequently, it was felt that special regulations should be promulgated by The Food and Drug Administration and the Production and Marketing Administration to allow the presence of considerable mold in the finished product.

If the presence of molds is to be used as an indication of a poor raw product, governmental regulations should allow the producer and canner to meet the regulation with a reasonable amount of effort, certainly until such time as researchers can develop methods or processes to eliminate these molds. Such procedures are not uncommon. The original tolerance for mold in tomatoes was high; however, as better field methods and cannery practices were developed, the allowable mold count was continually lowered. It is possible that further experimental work with tomatoes, resulting in better growing and handling methods, may reduce this to a negligible amount, and such may well be the case with black raspberries.

A study of the various factors influencing the mold count of processed black raspberries has been made in Michigan. This study included a) harvesting the fruit at different stages of maturity and at different intervals after rainfall, b) shaking the berry bushes before harvesting the fruit, c) holding wet and dry berries for different intervals between harvesting and processing, and d) subjecting the berries to various washing methods.

It was impossible to examine all of the fruit at the time of harvest; therefore, carefully selected berries were harvested, placed in suitable containers, and frozen for examination at a later time.

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Detection of molds in black raspberry pulp is extremely difficult because of the deep color of the fruit. Consequently, it was necessary to dilute the pulp prior to examination for molds.

The stages of maturity at which the black raspberries were harvested for subsequent mold counts were the "shiny black," "dull black" and "soft ripe." In addition, composite samples were also examined. In the initial phase of this work, harvested berries were divided into various stages of maturity, but the tremendous number of samples involved and the impracticability of such careful sorting soon became apparent.

The mold count in the shiny black raspberries was always low. When the number of days after rain was the variable factor, the shiny black fruits continued to ripen and their mold count continued to increase. The soft berries not harvested fell from the bushes; the dull black ones became soft, and the shiny black became the dull black ones. The berries which had been red or green at the time of the rain became shiny black fruit 4 or 5 days after the rain.

Soft berries showed the highest mold count. This was the case whether they were harvested in fair weather after rain, before or after the bushes were shaken, or regardless of the handling practices. The dull black berries were higher in mold count than were the shiny black ones under all conditions, but the count was lower than that of the soft fruit. In each instance the shiny black fruit had the lowest mold count. Whenever separate samples were taken, a composite sample, which might be representative of fruit harvested by the average picker, was also taken. In general, the composite sample had a higher mold count than did the shiny black or dull black fruit and a lower mold count than did soft fruit at harvest, but the increase in mold count was greater than in any graded sample during the holding period.

It was observed that a heavy rain deposited water between druplets of the berries, and in many instances it disrupted the skin of the uppermost druplets of soft fruit. Other than wetting, the rains caused no physical injury to dull black or shiny black berries. It was also noted that the soft berries and fruits having disrupted druplets were not firmly attached to the bushes. This suggested the procedure of shaking the plants to remove these fruits. When drops of water adhered to the soft fruit, following rain in the mid-harvest or late harvest periods, a very high percentage of these soft, disrupted, and often molded fruits could be removed by hitting or violently shaking the bushes. The remaining, good quality fruit could then be harvested without serious contamination by the soft fruits (Figs. 1-4).

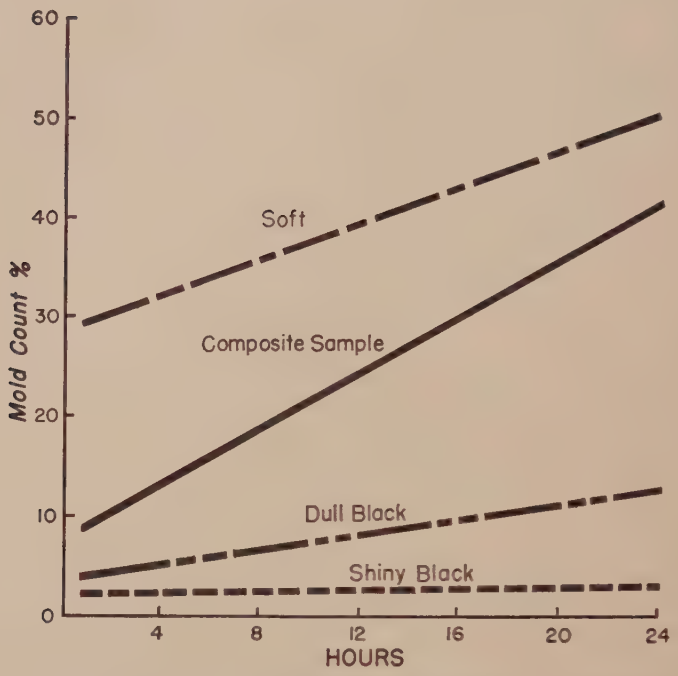

Fig. 1. Increase of mold count (in percent) in respect to time after rain.

Of the three maturity samples, the soft fruit showed the greatest increase in mold count as the time increased after a rain; the dull black fruit showed some increase, and the shiny black berries practically no increase. The composite sample had the greatest increase in mold count.

The shaker washer, ordinarily employed in commercial processing, does not adequately remove the mold from the berries. Berries placed in a soaker washer and finally sprayed with water under pressure were considerably cleaner. In the latter process the berries are separated, the sand or dirt is washed off, and the soft and broken fruit is completely broken up and washed away in the spray water.

Various experimental dilutions of samples were made in order to make the threads of the mold easier to count. It was observed that the greater the dilution, the less the percentage of mold, but this decrease was not a direct proportion; a 1-1 dilution was used as a standard and further dilutions as high as 14-1 were tried. The 1-1 dilution gave more exact results.

This experimental work indicates that the shiny black fruit is ideal for processing. Although there were varietal differences, the shiny

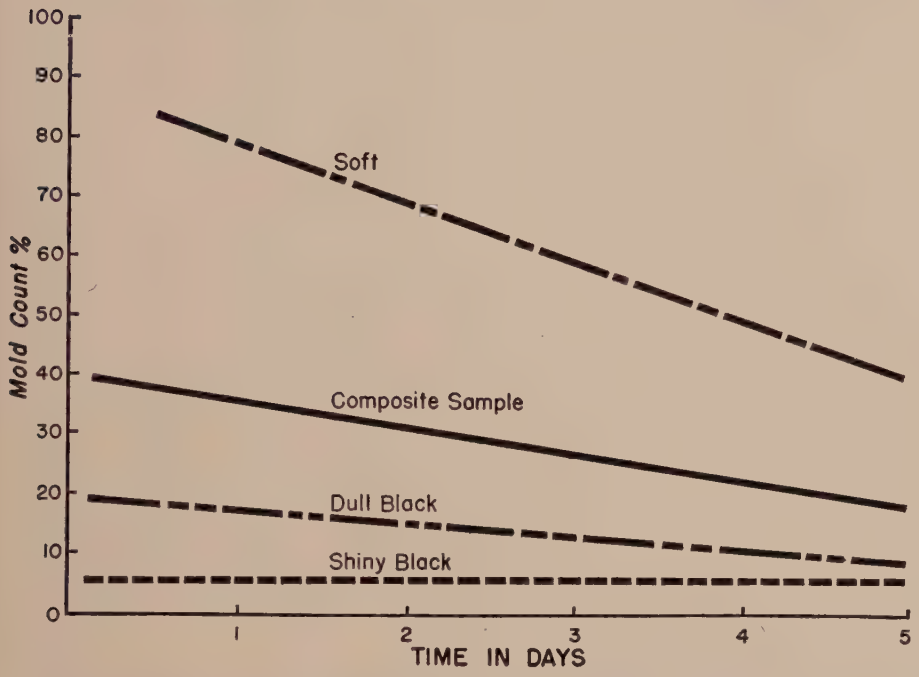

Fig. 2. Mold count (in percent) at harvest on successive days after rain. The decrease in mold count of soft, dull black and composite samples is due to the soft berries having fallen from bushes.

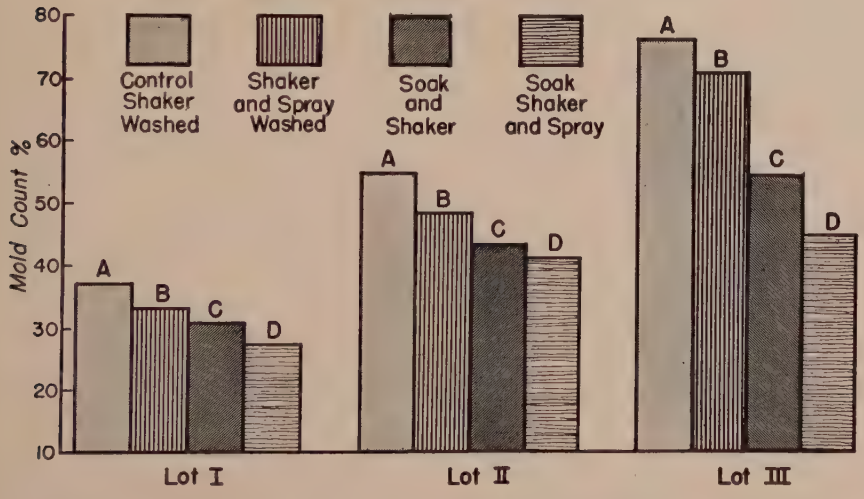

Fig. 3. Mold count of berries harvested after the bushes were shaken. This variation in varieties may be partially due to variation in ripening dates. Low counts show less effect of washing than higher counts.

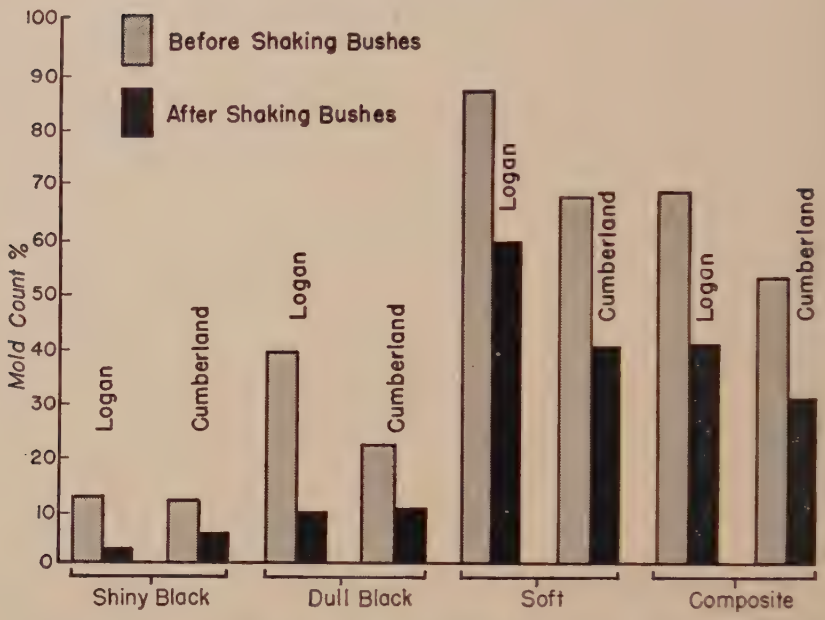

Fig. 4. Effect of washing treatment on mold count. The variation in lots depended on the number of soft fruit in each lot.

black raspberries always had the lowest mold count and were, therefore, the most suitable for processing purposes. Whenever rainfall or other factors delayed harvest, the resultant soft or partially decomposed fruits could be eliminated by shaking the bushes or by washing the picked berries with heavy sprays of water.

FUNGICIDES FOR THE CONTROL OF DAMPING-OFF IN TOMATOES[1]

By M. C. STRONG[2]
DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

WHILE MOST of the Michigan tomato crop for processing is produced from southern-grown plants, about 8,100 acres of market garden tomatoes, as well as the plants for the home garden crop, are locally grown from seed. In the production of these plants, considerable losses may result from a disease known as "damping-off." This trouble is caused by several fungi that are natural inhabitants of soil, and which are able to parasitize and kill the succulent seedlings both before and after emergence.

The losses from damping-off may be prevented by steam sterilization of the seedbed soil. Flats and tools must also be sterilized and caution observed to avoid recontaminating steamed soil because the disease may be very severe in sterilized soil that is accidentally recontaminated. When steam sterilization is impossible, the grower must rely on various chemical treatments for the protection of the seedlings during the 3- or 4-week period when they are susceptible to the disease. Older seedlings are not susceptible to this trouble.

The study here reported was undertaken to evaluate some of the newer fungicides for the control of damping-off. The fungicides tested are listed in Table 1. These chemicals were applied in three different ways — as dust treatments of seed before sowing, soil treatments before sowing, and sprinkle treatments after sowing.

The seed used in these tests was Ferry-Morse variety Marglobe having a germination of 92 percent. The soil used was a naturally infested garden soil having a pH value of 5.6. *Rhizoctonia*, *Pythium* and *Fusarium* were isolated from this soil as well as from the infected tomato seedlings.

Four series of tests were conducted in the greenhouse during the winter, spring, and fall of 1953 under varying conditions of tempera-

[1]Contribution 54-1 from the Department of Botany and Plant Pathology.
[2]The author wishes to thank the Ferry-Morse Seed Co. for the tomato seed used in these tests and the agricultural chemical companies listed who supplied the fungicides.

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TABLE 1—Fungicides tested for the control of damping-off in tomatoes

Trade name	Active ingredient	Manufacturer
Cuprocide	yellow copper oxide	Rohm & Haas Co.
Orthocide	N-trichloro methylthio tetrahydrothalimide (captan)	California Spray-Chem. Corp.
Crag 658	copper zinc chromate	Carbide & Carbon Chem. Corp.
5400	experimental fungicide	Carbide & Carbon Chem. Corp.
TMTD (75%)	tetramethyl thiuramdisulfide (thiram)	Niagara Chem. Div. of Food Machinery & Chemical Corp.
Arasan (50%)	" "	E. I. duPont & Co.
Tersan (50%	" "	"
Manzate	manganese ethylenebis-dithiocarbamate	"
Mathieson 275	pentachloro-nitrobenzene	Mathieson Chem. Corp.

ture, moisture, and light intensity. Four lots of 100 seeds each were used for each treatment in each series. Untreated seed lots and untreated soil were employed as controls for comparison with treatments in every series of tests.

DUST TREATMENTS

Lots of 100 seeds were dusted with the fungicide by being shaken in a jar until the seeds were well coated. Excess dust was screened off and the seeds planted 100 to the row in flats of the naturally infested garden soil. Stand counts were made 5 weeks after sowing. The results of the four series of tests are recorded in Table 2. Comparison of seedlings from dusted and untreated seed is shown in Fig. 1.

The use of Manzate as a dust treatment was discontinued after three trials because of poor seedling emergence. Orthocide 75 (captan 75 percent) produced some burning of leaves without reducing emergence.

SOIL TREATMENTS

Flats were prepared with a tight-fitting wooden divider in the center. Enough soil to fill a half flat was mixed with the fungicide at the rate of 1.6 grams per square foot (150 pound per acre). The mixture was put in a metal drum with baffles, which was turned 39 times. Treated soil was allowed to stand for 5 days before the seed was sowed. Four rows of 100 seed each were then sowed in each lot of treated soil.

Fig. 1. Comparison of tomato seedlings from untreated seed and chemically dusted seed 4 weeks after sowing. Upper row, left to right: seed treated with Arasan, untreated control, seed treated with TMTD 50 percent dust, seed treated with Cuprocide; lower row, left to right: seed treated with Crag 5400, Crag 658, Orthocide 75, Manzate.

TABLE 2—Comparison of stand counts 5 weeks after sowing tomato seeds dusted with various fungicides and untreated. Average of four 100 seed lots for each trial, 1953

Fungicide		Crag 5400	Crag 658	TMTD* 50%	Cuprocide	Arasan	Orthocide 75	Manzate	Untreated control
Trial	Date								
1	Jan.	85	81	87	82	76	76	32	55
2	Feb.	79	78	85	85	89	88	16	31
3	Mar.	86	81	84	84	84	79	33	50
4	Nov.	82	80	83	81	83	78	..	35
Average....		83	80	85	83	83	80	37	48

*TMTD 75% diluted with talc to make a 50% TMTD dust.

Fig. 2. Comparison of tomato seedlings grown in treated and untreated soil 3 weeks after sowing. Upper row, left to right: untreated soil, soil treated before sowing with Tersan 50 percent, Crag 5400, TMTD 75 percent. Lower row, left to right: soil treated before sowing with Orthocide 406, Manzate, Orthocide 406 sprinkle treatment, TMTD 75 percent sprinkle treatment. Seedlings in the two sprinkle treatments are 1 week older than those in the treated and untreated soil. Orthocide-treated seedlings show burning at the leaf tips.

TABLE 3—Comparison of stand counts 5 weeks after sowing tomato seeds in untreated soil and soil treated with various fungicides. Average of four 100 seed lots for each trial, 1953

Fungicide		Orthocide 406	Manzate	Crag 5400	TMTD 75%	Tersan 50%	Mathieson 275	Untreated control
Trial	Date							
1	Jan.	51	78	79	79	91	..	55
2	Feb.	69	89	76	85	88	..	31
3	Mar.	..	82	..	80	81	..	50
4	Nov.	..	80	..	84	86	79	35
Average.....		65	82	77	82	86	79	48

Emergence of seedlings in treated soil was considerably slower than in untreated soil under the same conditions. Comparison of plant size 3 weeks after sowing is shown in Fig. 2. Stand counts are given in Table 3.

Orthocide 406 (captan 50 percent) was discontinued after two trials because of the serious burning produced on the seedlings. Mathieson 275 was included in the November 1953 test and showed some promise as a soil treatment. Crag 5400 was used in only two trials because emergence was better when this material was applied as a dust.

SPRINKLE TREATMENTS

Four lots of 100 seed each were sowed for each treatment. The fungicide was applied at the rate of 0.5 gram per square foot of soil immediately after sowing the seed. Two more applications were made at 5-day intervals. The weighed amount of fungicide was suspended in 20 cc. of water and applied with a florist's bulb sprinkler.

Burning of seedlings with Orthocide 406 was noticed after the second application and is shown in Fig. 2.

Results from the sprinkle treatments shown in Table 4 were so divergent from one trial to another that they were discontinued after the third test as being too unreliable. There may be other fungicides better adapted to this type of treatment.

TABLE 4—Comparison of stand counts 5 weeks after sowing tomato seeds. Seedbed untreated and seedbed sprinkled with fungicide suspensions three times at 5-day intervals. Average of four 100 seed lots for each trial, 1953

Fungicide		TMTD 75%	Orthocide 406	Untreated control
Trial	Date			
1	Jan.	80	75	55
2	Feb.	38	50	31
3	Mar.	56	42	50
Average		58	55	44

CONCLUSIONS

The sprinkle treatments tested seemed to be unreliable for the control of damping-off.

All the dust treatments tested effected good control of damping-off in tomato seedlings with the exception of Manzate. However, when used as a soil treatment, Manzate offered good damping-off control.

Captan produced burning of the tips and edges of the leaves from all three types of application. Least injury was produced by the dust treatment.

With the exception of Manzate, all of the fungicides which were tested both as soil treatments and dusts were just as effective in the latter type of application. In view of the fact that seed dusting is easier, as well as requiring less fungicide, this method would seem to be more desirable than soil treatment. Tomato seeds are particularly adapted for dust treatment because the abundant hairs on the seed coat help retain the fungicide. Cuprocide, Arasan, TMTD dust, Crag 658 and 5400 controlled damping-off satisfactorily without causing injury to the seedlings.

It should be pointed out that in addition to the use of fungicidal treatments for the control of damping-off, good cultural practices must also be observed. Recommendations for the control of damping-off of tomato seedlings may be summarized as follows:

1. Steam sterilize seedbed soil, flats and tools, and exercise care to avoid recontamination.
   Or treat seed or soil with fungicide.
2. Put the seedbed in condition to allow good drainage.
3. Sow seed thinly in rows, not broadcast.
4. Avoid excess moisture; water only when soil surface is dry.

TESTING HALF-AND-HALF HOMOGENIZED MILK: A SUGGESTED PROCEDURE

By B. J. DEMOTT, E. S. HUMBERT and G. M. TROUT
DEPARTMENT OF DAIRY

HALF-AND-HALF homogenized milk, a product which contains from 10 to 12 percent fat and from 8 to 10 percent solids-not-fat, has become widely accepted by the consumer and milk processor as a standard dairy product.

As a result of the increased interest in half-and-half homogenized milk, a simple, accurate fat test is needed for this product. Already, several modifications of the Babcock procedure for homogenized milk have been outlined. A further modification of one of these procedures might well serve as a reliable test for this product. To that end the studies reported in this paper were made[1].

PROBLEMS ENCOUNTERED

In the testing of half-and-half, several problems arise which are nonexistent in the testing of milk and cream. These are: a) the product contains too high a percentage of fat to be tested in the 8- or 10-percent milk-test bottle; b) the smallest division on the neck of the cream-test bottle permits reading only to 0.5 percent which is not sufficiently close for a 10-percent product; c) the product is generally homogenized; thus, it is subject to the defects of the Babcock fat test for homogenized milk; d) solids-not-fat frequently are added, which require additional reagent for hydrolysis; e) the product is sufficiently viscous that difficulty is encountered in pipetting the sample into narrow-neck test bottles; and f) the product may vary so markedly in specific gravity and viscosity that test portions must be weighed for accuracy.

Two agencies (Michigan Department of Agriculture, 1953; U. S.

[1]After this study was started, an article by Dr. R. B. Maxcy, appearing in The Milk Dealer, 42 (4): 42 (1953), gave a suggested modification of the Babcock test for half-and-half homogenized milk.

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Public Health Service, 1953) recently defined half-and-half as follows:

> 1. "Half and half is a homogenized product resulting from combining or mixing milk and cream, with or without the addition of non-fat milk solids, and shall contain not less than 10.00 percent butterfat and shall have a specific gravity at 60 degrees Fahrenheit not greater than 1.033." (Michigan).
>
> 2. "Half and half is a product consisting of a mixture of milk and cream which contains not less than 11.5 percent milk fat." (United States).

As is evident, homogenization does not enter into the definitions of half-and-half. Yet – to provide for the desired homogeneity and viscosity – homogenization, and possibly the addition of 1 to 2 percent of solids-not-fat, must be prerequisites for the manufacture of the best quality product. These add to the problems of making a quick, reliable fat test.

PROCEDURES

Upon examination of the different methods used for testing homogenized milk, that given by Brunner, Trout and Lucas (1949) seemed to be the one which could be adapted most easily for use with half-and-half. Essentially, this method consists of adding 3 ml. of normal butyl alcohol to an 18-gm. sample and then completing the procedure as in a regular Babcock test, reading with glymol.

A number of modifications of this technique were studied, using standard calibrated Babcock glassware and a Babcock centrifuge throughout the study.

The modifications included:

a) reading the fat column with and without glymol;

b) the addition of various amounts of normal butyl alcohol;

c) the use of standard Babcock test bottles generally, other than the milk-test bottle;

d) variations in the amount and time of adding of butyl alcohol with respect to the addition of water; and

e) weighing as compared with measuring the sample to be tested.

The Mojonnier test, used as a control, was carried out according to the recommendations of Mojonnier and Troy (1925) for cream testing 25-percent fat or less.

RESULTS

After many trials and much experimentation three procedures showed promise for testing half-and-half homogenized milk for fat. Basically, these procedures a) employed Babcock testing glassware and technique; b) involved the addition of normal butyl alcohol; and c) relied upon glymol to remove the menisci.

The special features of the different methods were as follows:

Procedure A. A 9-gm. sample was weighed into an 8 percent, milk-test bottle. The fat column reading was doubled.

Procedure B. A 9-gm. sample was weighed into a 9-gm., 20-percent, ice cream-test bottle. The fat column reading was direct, using glymol.

Procedure C. Two ml. of normal butyl alcohol were used. The 17.6 ml. sample was pipetted into a 9-gm., 50-percent, cream-test bottle. The fat column reading was halved after reading with glymol.

The data obtained in testing half-and-half using these methods, in comparison with the Mojonnier test as a standard, involving 12 trials, are presented in Table 1. An examination of the data shows no significant differences between the results of any one of the modified Babcock tests and those of the Mojonnier method. Nevertheless, the algebraic average of deviations of the fat tests obtained by method B from the Mojonnier method indicated that method B might be the preferred procedure. Also, provided the test is equally accurate, other features of this technique would seem to make the test more desirable than procedures A or C. The chief differentiating features of method B over methods A and C are: a) the sample is weighed rather than measured; and b) the test bottle is designed specifically for a 9-gm. sample so that multiplying or dividing the fat reading by a factor is unnecessary. Accordingly, it is believed that in routine testing of half-and-half homogenized milk for fat, the following method will yield results which are accurate within the limits of the test itself and, at the same time, will yield a fat column of sufficient clarity which will give the operator assurance as to the reliability of the test:

1. Temper the sample to be tested and the sulfuric acid (commercial grade, sp. gr. 1.825 – 1.830) to 60 – 70° F.

2. Weigh out 9 gm. of the well mixed sample into a 9-gm., 20 percent ice cream-test bottle.
3. Add 1 ml. of normal butyl alcohol and mix.
4. Add 9 ml. of water and mix.
5. Add 18 ml. of sulfuric acid in three portions (9, 5 and 4 ml.) shaking well with a rotary motion between each and after the final addition of the acid.
6. Centrifuge, add water and temper the fat column in accordance with the regular Babcock procedure for milk.
7. Add glymol and read directly.

TABLE 1—Percentage of fat in half-and-half homogenized milk as tested by the Mojonnier method and by various procedures using standard Babcock glassware

Mojonnier test, percent	The percentage of fat in half-and-half homogenized milk as determined by procedure					
	A		B		C	
	Average of duplicate determinations, percent	Difference from Mojonnier	Average of duplicate determinations, percent	Difference from Mojonnier	Average of duplicate determinations, percent	Difference from Mojonnier
10.50	10.55	+0.05	10.60	+0.10	10.62	+0.12
11.27	11.30	+0.03	11.20	−0.07	11.25	+0.02
11.19	11.05	−0.14	11.30	+0.11	11.25	+0.06
10.53	10.55	+0.02	10.60	+0.07	10.50	−0.03
10.89	11.00	+0.11	11.20	+0.31	11.00	+0.11
11.30	11.35	+0.05	11.25	−0.05	11.12	−0.17
12.30	12.05	−0.25	12.00	−0.30	12.25	−0.05
10.26	10.10	−0.16	10.30	+0.04	10.50	+0.24
9.95	9.95	0	9.90	−0.05	10.00	+0.05
10.14	10.00	−0.14	10.20	+0.06	10.50	+0.36
10.53	10.60	+0.07	10.55	+0.02	10.50	−0.03
10.21	10.10	−0.11	10.05	−0.16	10.25	+0.04
Algebraic average....	.....	−0.039	.....	+0.006	.....	+0.06
Standard deviation..	.....	±0.033	.....	±0.044	.....	±0.040

DISCUSSION

Since half-and-half homogenized milk contains from 10 to 12 percent fat, 8 to 10 percent solids-not-fat, and is homogenized, the testing of its presents some problems not encountered in testing cream or homogenized milk. At present, specific Babcock glassware is not provided for a 10- to 12-percent milk. Hence, the test must be adapted to the available Babcock glassware. Also, the viscosity and/or specific gravity of the product may vary so markedly from milk that a measured sample may not yield a reliable weight on which the test is based. Although weighing the sample is more time-consuming than pipetting it, the product is of such a nature that for accuracy the sample should be weighed. Furthermore, the product, usually being homogenized, is heir to the difficulties encountered in the testing of homogenized milk.

Since this study was begun, Maxcy (1953) reported a method for testing half-and-half homogenized milk. Naturally, trials were run, using the Maxcy method. The present study corroborated the accuracy claimed for the test. But, since the test seemed to lack the time-saving and simplicity features desired and sought for, further studies with it were discontinued.

Sagers and Sanders (1952) suggested that detergents might be used for testing milk for butterfat. However, the procedure outlined by them required boiling the sample and reagent mixture for 15 minutes. Again, the lack of the time-saving elements caused this method to be rejected from the study. Nevertheless, an attempt was made without success to use tergitol-7 wetting agent as the sole emulsifying agent, as described by Stine and Patton (1952) for nonhomogenized 40-percent cream. While this technique proved satisfactory for testing the natural-state heavy cream, half-and-half homogenized milk did not respond satisfactorily to that treatment.

Brunner *et al.* (1949) reported success when using a small quantity of normal butyl alcohol in making the Babcock fat test of homogenized milk. These authors found, however, that the use of an excess of 3 ml. normal butyl alcohol with a 17.5 ml. sample of homogenized milk resulted in a fat test 0.1 percent above that obtained by the Mojonnier method. Similar results were found in the present study when the volume of normal butyl alcohol was increased from 1 to 2 ml. on a 9-gm. sample.

In all, 16 methods and/or variations of testing half-and-half were tried for accuracy and desirability. The method which seemed to

offer the best possibilities for routine milk plant laboratory usage was the one which involved weighing 9 gm. of the sample into a 9-gm., 20-percent ice cream-test bottle, followed by the addition of normal butyl alcohol and the use of the modified Babcock procedure. This method is superior when one considers such advantages as the saving of time over other methods, the accuracy and relative simplicity, the direct reading of the fat column, and the comparative freedom of the test from char.

It should be noted that in some methods of processing half-and-half no solids-not-fat are added; hence, it would be advisable to decrease slightly the amount of acid to 17 ml. or to the point where no darkening of the fat column occurs. However, perhaps the most important feature of the recommended procedure is the thorough shaking of the samples after each addition of the acid. In this way the black ring below the fat column, which is characteristic of defective homogenized milk tests, is largely eliminated.

SUMMARY

The fat content of half-and-half homogenized milk was determined by means of various modifications of the Babcock method and by several existing potential techniques.

The following simple, direct, Babcock procedure seemed to yield accurate and clear fat columns more consistently than did the other tests:

1. Use a 9-gm., 20-percent ice cream-test bottle.
2. Temper the product and sulfuric acid (sp. gr. 1.82 – 1.83) to 60 – 70° F.
3. Weigh directly into the test bottle 9 gm. of the well mixed sample.
4. Add 1 ml. normal butyl alcohol and shake vigorously.
5. Add 18 ml. sulfuric acid in three portions (9, 5 and 4 ml. respectively), machine-shaking the samples between each and after the final addition of acid.
6. Centrifuge according to the Babcock technique for milk.
7. Temper the fat column to 135-140° F.
8. Add glymol and read the fat column directly.

Twelve samples of half-and-half homogenized milk, which were tested for fat in duplicate by the foregoing procedure, averaged 0.006 percent higher than when tested by the Mojonnier method.

LITERATURE CITED

Brunner, J. R., G. M. Trout, and P. S. Lucas (1949). A modified Association-Babcock test for homogenized milk. Mich. Agr. Expt. Sta. Quart. Bul. 31 (4): 441-444.

Maxcy, R. B. (1953). A suggested modified Babcock procedure for testing half-and-half. The Milk Dealer. 42 (4): 42, 43, 52, 54.

Michigan Department of Agriculture (1952). Act No. 169, Public Acts of 1929, as amended, p. 2. (Letter, F. M. Skiver, Bur. of Dairying, Lansing, July 1, 1952, to all fluid milk plants and distributors).

Mojonnier, T., and H. C. Troy (1925). *The Technical Control of Dairy Products.* 2nd ed. Mojonnier Bros. Co. Chicago. 936 pp., plus xxi.

Sager, O. S., and G. P. Sander (1952). A. B. D. I. detergent test for butterfat in milk and other dairy products. Conv. Proc. Milk Indus. Found. (Lab. Sect.), 4: 29-42. Chicago.

Stine, C. M., and S. Patton (1952). Preparation of milk fat. II. A new method of manufacturing butteroil. Jour. Dairy Sci. 35: 655-660.

United States Public Health Service (1953). Milk Ordinance and Code. Pub. Health Bul. 220, p. 4. (Rev.).

THE FEEDING VALUE OF PEA AND OAT SILAGE FOR DAIRY COWS

By C. F. HUFFMAN, S. T. DEXTER and C. W. DUNCAN
DEPARTMENTS OF DAIRY, FARM CROPS AND AGRICULTURAL CHEMISTRY

IN AREAS OF MICHIGAN where the growing season does not permit the profitable growing of corn for silage, a pea and oat mixture may offer a suitable temporary silage crop. Such silage has been fed to dairy cattle, yet its feeding value has received very little consideration. Digestion trials have been carried out with sheep, but not with cattle. Bechdel (1923) reported that pea and oat silage was superior to hay, but inferior to corn silage for milk production.

The objectives of this study were to determine: a) the coefficients of digestibility, and b) the value of pea and oat silage for milk production.

EXPERIMENTAL

One bushel each of pea and oat seed was planted per acre, and the crop was harvested and placed in a tower silo when the oats were in the late-milk or early-dough stage and when the pods of the peas were three-fourths developed.

Two cows were used in digestion studies to determine the coefficients of digestibility of the pea and oat silage. They were placed on the silage alone 20 days prior to the starting of the fecal collection period. The feces was collected each day for 7 days, and aliquot samples were saved for chemical analysis.

Fourteen Holstein, two Jersey, and two mixed-breed cows were used in 18 trials, on a reversal system, to determine the value of the silage for milk production. The pounds of milk produced were calculated as 4-percent fat-corrected milk. The periods when pea and oat silage was fed varied from 12 to 18 days. The basal periods varied from 9 to 27 days. Two clover-timothy basal hays were used. These hays were graded U. S. No. 2 in respect to color and leaf. Digestion coefficients were determined for these hays. The coefficients suggested by Morrison (1948) were used to determine the digestible

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protein and total digestible nutrient content of the corn and solvent-extracted soybean oil meal. The requirements recommended by Loosli *et al.* (1950) were used. In trials 1, 2, and 3, from 36.5 to 38 pounds of pea and oat silage replaced 6 pounds of corn and 3 pounds of soybean oil meal. In trials 4 to 8, inclusive, from 19.8 to 24.7 pounds of pea and oat silage replaced 6 pounds of corn. In trial 9, 40.9 pounds of pea and oat silage replaced 14.7 pounds of basal hay (No. 4). This cow was fed 6 pounds of corn and 2 pounds of glucose (corn sugar) daily. In trials 10, 11, and 12, from 75.2 to 83.6 pounds of pea and oat silage replaced all of the grain and all of the hay in the ration. In trials 13 to 18, inclusive, all or a part of the basal hay (No. 2) was replaced by the pea and oat silage and was fed according to the appetite of the cow. The cows were weighed every third day at about the same time of day.

RESULTS AND DISCUSSION

The chemical analysis of the pea and oat silage, as fed, is presented in Table 1. The protein, ether extract, crude fiber, nitrogen-free extract, and total digestible nutrients were 15.7, 4.24, 28.5, 42.1, and 58.4 percent, respectively, on the dry basis. The high protein content was due to a greater proportion of peas in the mixture. The high ether extract was probably due to the presence of organic acids formed during fermentation. In the calculation of total digestible nutrients, the digestible ether extract fraction of the silage was not multiplied by 2.25. The pH of the silage was 4.0 which accounted, in part, for the good quality of the silage. The carotene content was 147 micrograms per gram, on the dry basis.

Two dry cows were used to determine the coefficients of digestibility of the pea and oat silage, and the results are presented in Table 2. The average coefficients of digestibility of the protein, ether extract, crude fiber and nitrogen-free extract were 68, 58, 64, and 63, respectively. According to Morrison (1948), the average coefficients of digestibility of protein, ether extract, crude fiber, and nitrogen-free extract of pea and oat silage by sheep are 60, 67, 65, and 66, respectively. In the current project, the total digestible nutrients of the pea and oat silage were 58.4 percent, on the dry basis, compared with 61.5 in the data summarized from the literature by Morrison (1948). The total digestible nutrient content of the two clover hays (Feed No. 3 and 4), used as basal hays, was 50.8 and 48.3 percent, respectively, on the air-dry basis.

The pea and oat mixture, when placed in the silo, made good silage in respect to odor, appearance, and acidity (pH 4). The cows ate the silage with relish, which indicated good palatability. In trials 10

TABLE 1—The percentage composition, coefficients of digestion, digestible protein (Dig. Pro.), and total digestible nutrients (T. D. N.) of feeds used

Feed No.	Description	Moisture	D. M.†	Ash	Protein	Ether ext.	Crude fiber	N. F. E.†	Dig. pro.†	T. D. N.†
1	Oat-pea mixture (as put in silo).....	67.6	32.4	2.52	5.12	1.06	9.0	14.8	....	....
		0	....	7.78	15.8	3.27	27.6	45.5	....	....
2	Oat-pea silage (as fed).....	71.0	29.0	2.72	4.54	1.23	8.3	12.2	3.1	16.8
		0	....	9.38	15.7	4.24	28.5	42.1	10.7	58.4
	Coef. of digest.....	....	62.5	....	68.1	58.3	64.0	63.2	....	....
3	Clover-timothy (1951 crop).....	11.8	88.2	5.08	11.4	1.94	32.6	37.2	6.3	50.8
	Coef. of digest.....	....	58.9	....	55.7	36.7	60.9	61.9	....	....
4	Clover-timothy (1952 crop).....	12.0	88.0	5.42	9.9	2.22	29.1	41.4	4.8	48.3
	Coef. of digest.....	....	58.1	....	48.1	34.0	55.9	61.8	....	....
5	Corn, U. S. No. 2*.....	11.2	88.8	2.51	9.7	3.95	2.7	69.8	7.5	81.9
6	Soybean oil meal* (Solvent-extracted)....	10.2	89.8	5.38	45.6	1.26	5.6	32.0	42.0	78.3

*Morrison's coefficients (1948) used in calculating the total digestible nutrient values.

†Key to abbreviations:
D. M. = Dry matter
N. F. E. = Nitrogen-free extract
Dig. Pro. = Digestible protein
T. D. N. = Total digestible nutrients

TABLE 2—Coefficients of digestibility obtained from digestion trials for oat and pea silage

Cow No.....	T2	A73	Average
Dry matter.....	63.0	62.0	62.5
Protein.....	68.4	67.9	68.2
Ether extract.....	58.2	58.5	58.4
Crude fiber.....	64.8	63.2	64.0
Nitrogen-free extract.....	64.2	62.2	63.2

to 12, inclusive, there was a decline in dry matter intake owing to the animals' lack of appetite for the silage when the pea and oat silage replaced all the hay and grain. Similar results were secured in trials 14 to 18, inclusive, when oat and pea silage replaced all the hay in the all-roughage ration. The data indicate that a ration of silage without hay depresses dry matter consumption although the latter may seem to be palatable. These results illustrate the difference between palatability and appetite for dry matter. Palatability is only one factor involved in dry matter consumption. According to Hoflund *et al.* (1948), there is direct correlation between the rate of cellulose digestion in the rumen and dry matter consumption. The appetite for roughage increases in direct proportion to the rate of cellulose digestion in the rumen.

In trial 13, cow A53 consumed 92 pounds of silage in addition to 10 pounds of clover hay. With this amount of hay, there was no depression of dry matter consumption.

The nutritive value of pea and oat silage for milk production was investigated by three methods: a) replacement of all or part of the grain; b) replacement of all or part of the hay and grain; and c) replacement of all or part of the hay. The data are represented in Table 3. In trials 1 to 3, inclusive, the replacement of 6 pounds of corn and 3 pounds of soybean oil meal with 36.5 to 38.0 pounds of pea and oat silage resulted in no significant change in milk production. These cows, however, were over-fed on grain. In trials 4 to 8, inclusive, no significant change in milk production was observed when pea and oat silage replaced 6 pounds of corn, although slightly less total digestible nutrients were consumed during the silage-feeding periods. Similar results were observed in trial 9 when the grain was kept constant and pea and oat silage replaced part of the hay. Milk production declined during the pea-oat silage and the hay-grain periods. An increase in milk production was obtained when cow A53 (trial 13) was fed 10 pounds of hay and all the silage she would consume. The increase was associated with an increase in the total digestible nutrient intake. In trials 14 to 18, inclusive, the total digestible nutrient intake was reduced markedly, owing to a drop in dry matter consumption when all the hay was replaced with pea and oat silage. Although the dry matter intake decreased during the silage periods, milk production was not significantly changed. The cows in trials 12, 15, and 16 failed to consume sufficient total digestible nutrients to meet the requirements recommended by Loosli *et al.* (1950).

TABLE 3—The effect on milk production when part of the grain, all of the hay and grain, and part or all of the hay was replaced with pea and oat silage

Trial	Cow	In milk	Period	Body weight	Test	F.C.M.§	Feed intake:				Digestible Protein§		T.D.N.	D. M.
							Hay	Corn	SBOM§	Silage	Required	Received		
No.	*No.*	*day*	*days*	*lb.*	*%*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*%*
1	A71*	192	12	1099	3.2	32.8	22.0	12	3	....	2.13	3.55	23.4	32.8
		204	18	1154	3.4	30.4	20.0	6	..	38.0	2.04	2.89	21.5	34.0
		222	12	1108	3.3	28.7	22.0	12	3	....	1.94	3.55	23.4	32.8
2	A75*	64	12	1208	3.2	31.7	22.0	12	3	....	2.13	3.55	23.4	32.8
		76	18	1227	3.3	30.3	21.2	6	..	36.5	2.08	2.93	21.8	34.6
		94	21	1202	3.6	28.5	22.0	12	3	....	1.98	3.55	23.4	32.8
3	A76*	181	12	1141	3.2	30.5	21.8	12	3	....	2.04	3.55	23.3	32.6
		193	18	1149	3.5	30.4	21.5	6	..	36.9	2.04	2.96	22.0	35.0
		211	18	1156	3.3	31.1	22.0	12	3	....	2.08	3.55	23.3	32.8
4	T3†	104	12	873	3.9	25.6	19.9	8	..	....	1.69	1.56	16.2	24.6
		116	18	893	4.0	24.5	17.7	2	..	24.7	1.65	1.77	14.3	24.5
		134	21	888	3.8	22.2	19.1	8	..	....	1.54	1.52	15.8	23.9
5	T5†	62	12	771	4.2	25.9	17.3	10	..	....	1.65	1.58	16.5	24.1
		74	18	787	4.2	25.4	18.0	4	..	19.8	1.64	1.77	15.3	25.1
		92	15	762	4.3	26.0	18.0	10	..	....	1.65	1.61	16.9	24.7
6	T6†	130	12	658	4.5	22.0	14.0	10	..	....	1.42	1.42	14.9	21.2
		142	18	675	4.7	19.7	14.0	4	..	20.0	1.32	1.59	13.4	21.7
		160	15	672	4.7	20.0	13.9	10	..	....	1.34	1.42	14.9	21.1
7	T4†	21	12	913	3.9	32.0	20.3	8	..	....	2.00	1.57	16.3	25.0
		33	18	907	4.1	30.2	22.0	2	..	20.7	1.91	1.85	15.7	27.1
		51	18	884	3.6	27.6	22.0	8	..	....	1.78	1.66	17.2	26.5
8	T1†	100	12	919	3.5	17.7	19.9	6	..	....	1.36	1.41	14.5	22.8
		112	18	938	3.9	15.8	18.4	2	..	22.7	1.28	1.73	14.3	24.6
		130	18	928	3.7	14.9	19.7	6	..	....	1.23	1.40	14.4	22.7
9	A69†	28	12	1232	2.9	41.0	35.3	8‡	..	....	2.56	2.29	25.2	40.0
		40	15	1229	3.1	38.7	17.6	8‡	..	40.9	2.46	2.71	23.6	36.3
		55	12	1198	3.2	36.6	35.6	8‡	..	....	2.35	2.31	25.4	40.3

10	A80*	324	9	1160	3.9	19.2	26.0	4	..	....	1.54	1.94	16.5	26.5
		336	18	1147	4.2	15.6	....	..	..	75.2	1.38	2.33	12.6	21.8
		354	18	1142	3.9	15.7	26.0	4	..	....	1.38	1.94	16.5	26.5
11	A49*	153	12	1296	3.7	21.0	29.9	4	..	....	1.69	2.18	18.5	29.9
		165	18	1299	4.1	18.1	....	..	..	83.5	1.56	2.59	14.0	24.2
		183	15	1287	3.9	15.8	30.0	4	..	....	1.45	2.19	18.5	30.0
12	A48†	122	12	1088	3.9	21.5	25.9	4	..	....	1.61	1.54	15.8	26.3
		134	18	1109	4.1	19.7	....	..	..	83.6	1.54	2.59	14.1	24.2
		152	27	1115	4.0	18.0	25.2	4	..	....	1.47	1.51	15.4	25.7
13	A53†	19	12	1078	2.7	28.1	39.5	..	..	....	1.90	1.90	19.1	34.8
		31	12	1114	2.7	29.4	10.0	..	..	92.0	1.98	3.30	20.3	35.5
		43	21	1107	2.8	24.8	39.8	..	..	....	1.77	1.91	19.2	35.0
14	A78†	260	9	1086	3.7	11.4	37.9	..	..	....	1.16	1.82	18.3	33.4
		271	18	1080	3.7	9.8	....	..	..	87.3	1.08	2.71	14.7	25.3
		289	12	1106	3.9	7.8	38.2	..	..	....	1.00	1.83	18.4	33.6
15	442†	216	12	1272	3.5	20.8	28.0	..	..	....	1.67	1.34	13.5	24.6
		228	18	1294	3.5	19.1	....	..	..	85.0	1.61	2.63	14.3	24.6
		246	18	1271	3.2	13.1	28.0	..	..	....	1.32	1.34	13.5	24.6
16	A27†	112	12	1069	2.9	14.5	31.8	..	..	....	1.29	1.53	15.4	28.0
		124	18	1053	3.0	13.0	....	..	..	62.9	1.21	1.95	10.6	18.2
		142	18	1068	3.1	11.9	31.8	..	..	....	1.17	1.45	15.0	28.0
17	T10†	342	12	874	3.0	11.1	29.9	..	..	....	1.04	1.44	14.4	26.3
		354	18	873	3.0	11.6	....	..	..	62.8	1.06	1.95	10.6	18.2
		372	18	866	3.2	10.6	29.7	..	..	....	1.01	1.43	14.3	26.1
18	419†	216	12	1192	3.7	12.6	39.0	..	..	....	1.26	1.87	18.8	34.3
		228	18	1206	3.4	10.6	....	..	..	92.1	1.18	2.86	15.5	26.7
		246	12	1199	3.5	10.5	39.7	..	..	....	1.17	1.91	19.2	34.9

*Feed No. 3.
†Feed No. 4.
‡8 pounds of corn and 2 pounds of glucose daily.
§Key to abbreviations:
F. C. M. = 4-percent fat-corrected milk
SBOM = Soybean oil meal

In most of the trials, there was about the same rate of decline in 4-percent fat-corrected milk during the feeding of the pea and oat silage as during the control periods. It is apparent from the digestion trial data and milk production studies that oat and pea silage is comparable with good hay as a roughage for milking cows.

SUMMARY

One bushel each of pea and oat seed was planted per acre, and the crop was harvested and placed in a tower silo when the oats were in the late-milk or early-dough stage and the pods of the peas were three-fourths developed.

The composition of the pea and oat silage was as follows (in percentage unless otherwise stated): dry matter, 29.0; protein, 4.54 (dry basis, 15.7); ether extract, 1.23 (dry basis, 4.24); crude fiber, 8.3 (dry basis, 28.5); nitrogen-free extract, 12.2 (dry basis, 42.1), and carotene, 42.8 p. p. m. (dry basis, 147). The pH of the silage was 4.

Two cows were used to determine the coefficients of digestibility of the pea and oat silage. The average values were dry matter, 62.5; protein, 68.2; ether extract, 58.3; crude fiber, 64.0; and nitrogen-free extract, 63.2. The percentages of digestible protein and total digestible nutrients were 3.10 (dry basis, 10.7) and 16.8 (dry basis, 58.4), respectively.

Milk production was satisfactorily maintained in milking cows when pea and oat silage replaced a part of the grain, all of the hay and grain, and all or part of the basal hay.

When cows were changed from hay alone to pea and oat silage alone, the appetite for dry matter decreased.

LITERATURE CITED

Bechdel, S. I. (1923). Oat and pea silage for milk production. Pa. Agr. Exp. Sta. Bul. 178, Part II, pp. 12-23.

Hoflund, S.; J. I. Quin, and R. Clark (1948). Studies on the alimentary tract of Merino sheep in South Africa. XV. The influence of different factors on the rate of cellulose digestion (a) in the rumen and (b) in ruminal ingesta as studied in vitro. Onderstepoort J. Vet. Sci. Animal Ind., 23: 395-409.

Loosli, J. K.; C. F. Huffman, W. E. Peterson, and P. H. Phillips (1950). Recommended nutrient allowances for domestic animals. III. Recommended nutrient allowances for dairy cattle. National Research Council, Washington, D. C.

Morrison, F. B. *Feeds and Feeding.* 21st ed. The Morrison Publishing Co., Ithaca, N. Y. 1948.

TIME REQUIREMENTS FOR THE CLEANING OPERATIONS IN A DAIRY PLANT

By CARL W. HALL[1] and WILLIAM E. SHIFFERMILLER[2]
DEPARTMENT OF AGRICULTURAL ENGINEERING

FROM 17 TO 20 PERCENT of the total dairy plant labor cost is required for cleaning operations. A study was undertaken to determine the amount of time devoted to cleaning operations and to find methods of reducing the time. The study was conducted in 12 different dairy plants. The cleaning of equipment is often looked upon as an undesirable job, even though it is very important from the viewpoint of quality control and plant appearance. Reducing the time for cleaning equipment enables a worker to do more important, satisfying, and materially productive work. The knowledge of time requirements for a cleaning operation is valuable for planning work schedules and for selecting equipment.

METHOD OF CARRYING OUT TESTS

The data for the time requirements for the cleaning operations were obtained by making a time-and-motion analysis in 12 dairy plants in southern Michigan. From the time study data obtained, inefficient steps in the cleaning operations were eliminated. These inefficient steps were usually the result of an improperly arranged workplace, with wrenches, cleaners, and brushes not being readily available to the worker. The time for other steps attributed to the worker, such as that which he spent in talking to a fellow worker, or which was a part of another operation, such as supervising processing operations, was subtracted from the stopwatch time. After the inefficient steps in the operation were eliminated, the remaining values were combined to give the time for an efficient operation. The time requirements for cleaning various pieces of dairy equipment include an allowance of 20 percent in addition to the actual efficient working time (Fig. 1a and b).

[1]Associate Professor of Agricultural Engineering.
[2]Former Graduate Assistant in Agricultural Engineering.

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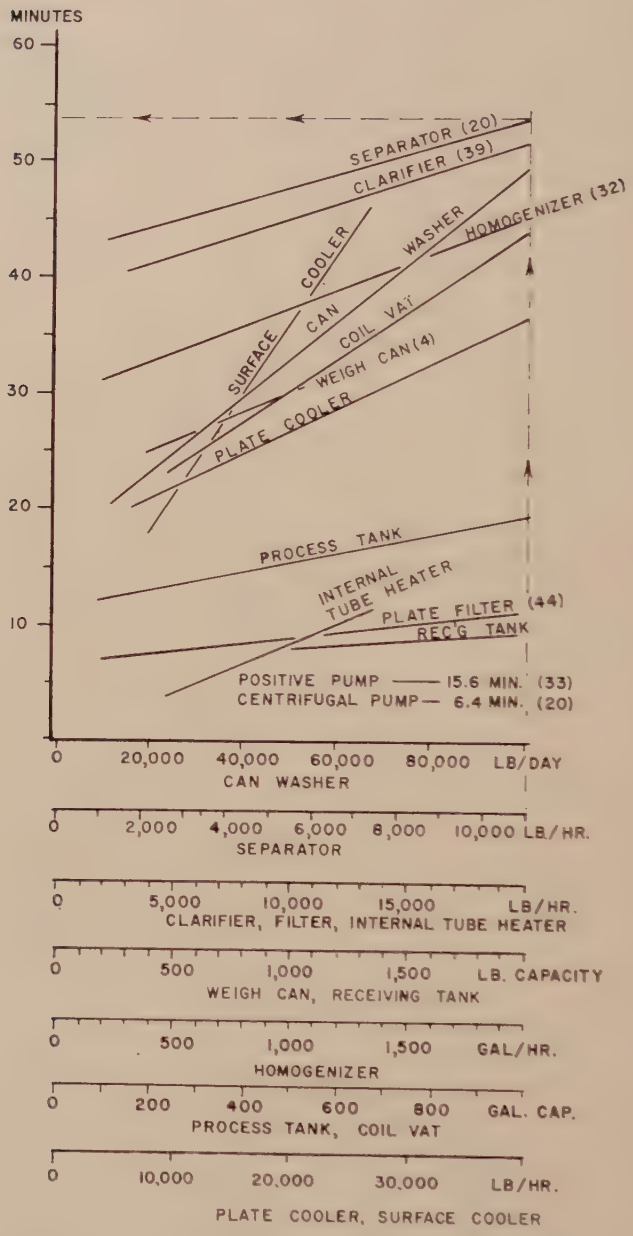

Fig. 1a. Approximate total daily cleaning time for various pieces of dairy equipment. (Numbers in parentheses represent approximate percentage of total time required for assembly of parts.)

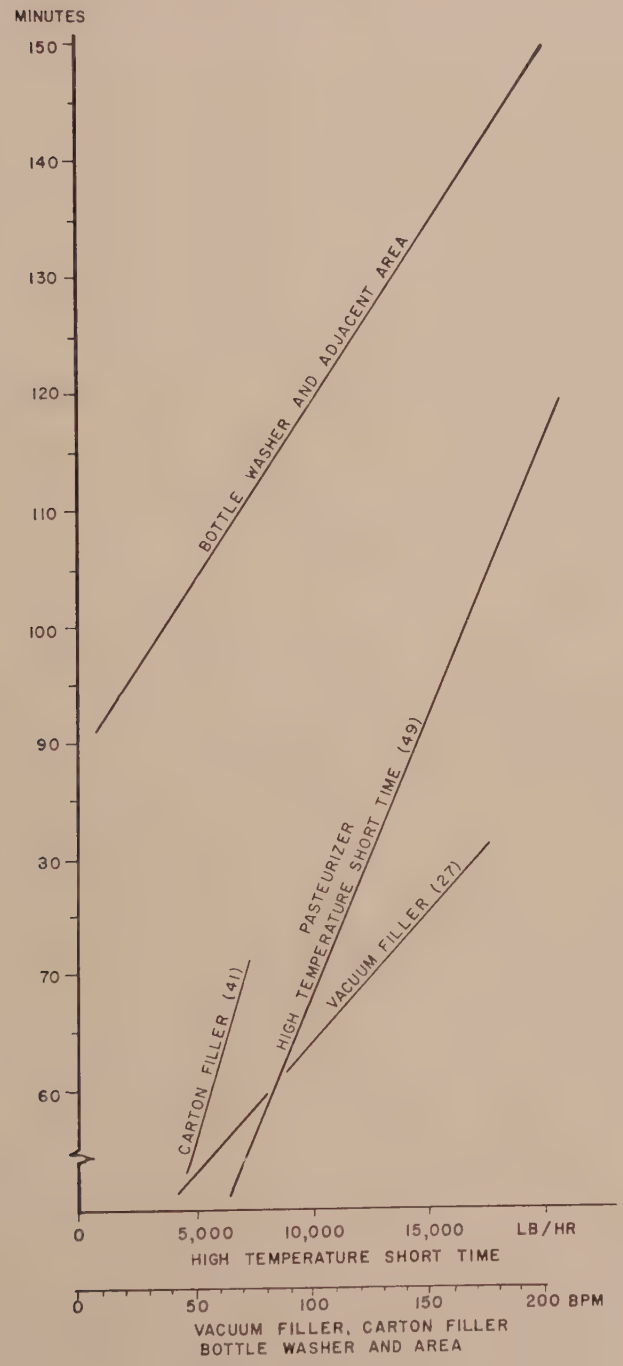

Fig. 1b. See Fig. 1a.

This allowance is given for fatigue, delay, and personal needs of the worker. No effort was made to improve the methods of the different workers.

RESULTS

The daily cleaning times for various pieces of dairy plant equipment are shown in Fig. 1a and b. The total daily cleaning time includes the time required for disassembly and assembly of the equipment. The time for the assembly, which is usually not carried out in sequence with the disassembly and cleaning of the equipment. is listed in Fig. 1a and b as a percentage of the total cleaning time. The assembly time thus determined can be used for planning work schedules in a plant.

How Fig. 1a and b can be used to determine the average cleaning time for a piece of dairy equipment, such as a 11,000-pound-per-hour separator, is illustrated as follows:

1) Locate the type and size of equipment on the bottom lines (11,000-pound-per-hour separator)
2) Then proceed upward to the line representing the piece of equipment in question (separator)
3) Read the total daily cleaning time in minutes (53 minutes)
4) Read the percent of total time required for assembly of parts (20 percent of 53 minutes equals 10.6 minutes daily)
5) Then, 53 minutes minus 10.6 minutes equals 42.4 minutes required for disassembly and washing daily.

As would be expected, there is an increase in time requirements for cleaning with an increase in the capacity of the equipment. This can be attributed to the fact that the milk surface area to be cleaned varies as the capacity of the equipment.

The time requirements presented for the cleaning operations represent averages and cannot be used for incentive wage standards because of the many different work areas encountered in various plants. The time requirements may be used for planning operational schedules and comparing the time requirements in a particular plant with those presented. A large deviation, particularly if considerably more time is required, would suggest that a method analysis be made based on the following recommendations which were formulated on the basis of the plant studies.

RECOMMENDATIONS

1. Eliminate excessive rinsing of parts, particularly the outside portions.
2. Handle parts of equipment as little as possible.
3. As the parts are disassembled and washed, they should be placed on a wash rack on which the parts may be rinsed and positioned for assembly. The water should be convenient for cleaning and rinsing. Materials and equipment should be close to the work areas.
4. Place the water hose on a self-winding reel. From 3 to 4 minutes are required to wrap the hose after use without a reel.
5. The water hose should not cross an alley. The movement of carts and trucks is hampered by a water hose across an alley.
6. Place a water valve on the cleaning end of the hose to save labor and water.
7. Locate equipment, such as pipe lines, so that it can be easily washed without ladders, steps, etc.
8. Have washing powders and solutions located near the point of use. It may be economical to have more than one storage space for washing solutions.
9. Investigate the possibility of having two men working together to clean one piece of equipment.

A ROLLING COULTER FURROW OPENER FOR DEEP PLACEMENT OF FERTILIZER

By C. M. HANSEN[1] *and R. E. LUCAS*[2]

Departments of Agricultural Engineering and Soil Science

Fertilizer recommendations for corn in Michigan (Anon. 1953), indicate that low rates of application of an analysis such as 3-18-9 or 3-12-12 at planting time are satisfactory if adequate amounts of nitrogen are sidedressed later. However, if all the fertilizer is to be applied at planting time, an analysis such as 10-10-10 or 12-6-6 would be necessary, particularly if the corn follows a non-legume crop. With applications of high-nitrogen fertilizers at planting time, a greater salt effect results in the soil. The placement of the fertilizer with respect to the corn seed thus becomes increasingly important. New applicators are needed to place at least a portion of these higher grade fertilizers at greater depths. Placing fertilizers at greater depths should result in their more efficient use by plants during dry periods.

The application of all the fertilizer at planting time will reduce the labor requirement and equipment costs as compared with the requirements for an additional application as a sidedressing during the growing season.

The split-boot fertilizer applicator found on most corn planters now in operation places the fertilizer on both sides and above the level of the seed. When the planter is operated at high speeds a portion of the fertilizer is left uncovered. This placement is not satisfactory.

BAND PLACEMENT OF FERTILIZER

Starter fertilizer application tests were made by Millar *et al.* (1947, 1948) and by Turk *et al.* (1949). In these studies, unfertilized plots were compared with plots which received 400 pounds per acre of 3-12-12 applied in three ways: 1) a commercial planter with split-boot applicator, 2) an experimental planter with a single band being placed

[1]Assistant Professor of Agricultural Engineering.
[2]Associate Professor of Soil Science.

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2 inches to the side and 2 inches below the seed, and 3) an experimental planter with a double band being placed 2 inches to the side and 2 inches below the seed. The average of the yields for these tests indicated no appreciable difference between the single and the double band method of fertilizer placement (Table 1). The tests, furthermore, showed that the optimum placement of the fertilizer for corn should be a band placed 2 inches to the side and 2 inches below the seed.

PLOWED DOWN FERTILIZER

Fertilizer which has been plowed down is more likely to remain in moist soil as compared with that applied with most conventional corn planters. Furthermore, if large amounts of fertilizer are used, there is less danger of salt injury to corn seedlings.

Research in Michigan by Millar *et al.* (1945) showed that plots fertilized by the plowed-down method did not yield as well as did plots fertilized in a single band 2 inches to the side and 2 inches below the seed (Table 2). Possible factors which may account for the low yield response obtained by the plowed down method are as follows:

1) Extended distances of the fertilizer from the plant, 2) fixation of the phosphorus by the soil, and 3) soil compaction after the fertilizer was plowed down. The latter factor bears further investigation.

*TABLE 1—Effect of fertilizer and fertilizer placement on corn yields, bushels shelled corn per acre**

Year, soil type	No fertilizer	Split-boot applicator	Band one side†	Band both sides†
	Bushels per acre			
1947				
Conover loam	19.4	19.9	26.5	27.2
Macomb fine sandy loam	29.1	35.2	37.8	40.3
1948				
Hillsdale sandy loam	27.8	36.1	34.5	37.4
Macomb loam	39.0	38.3	51.2	43.0
1949				
Miami loam	59.9	60.6	48.6	53.7
Wauseon sandy loam	64.0	72.7	76.3	70.1
Average	39.9	43.8	45.8	45.3

*These data from Millar *et al* (1947, 1948) and from Turk (1949). All fertilized plots received 400 pounds per acre 3-12-12.

†Fertilizer bands were placed 2 inches to the side and 2 inches below the seed.

Cook (1951) reported that the intake of potassium by corn roots was much faster when it was applied 6 inches below the seed at planting time than when plowed down 1 month prior to planting.

Better results might be obtained from plowed-under fertilizer if the corn were planted immediately after plowing. By such a practice the soil would be loose enough to allow quick penetration of the corn roots to the fertilizer bands. This idea will be tested by additional experiments.

The results of these earlier studies on fertilizer placement lead to the conclusion that a new type of fertilizer applicator was needed. Therefore a new applicator was developed that would place one band of fertilizer near the seed and a second band at a greater depth.

THE ROLLING COULTER FERTILIZER FURROW OPENER

Development work was started in 1953 on a furrow opener to simultaneously place one band of starter fertilizer 2 inches to the side and 2 inches or more below the seed; and, to place a second band 4 inches below the starter band (Fig. 1).

A furrow opener was mounted on each side of an 18-inch diameter rolling coulter (Fig. 2a). Each opener was forged in saber-like fashion from carbon steel (Fig. 2b). The leading edge of each furrow opener cleared the rolling coulter by 1/16 inch and had a radius of 2 feet in a plane parallel to the coulter (Fig. 2a and b). Cold rolled steel strips were welded to the training edge of the furrow openers, making a fertilizer passageway (Fig. 2a). One opener was adjusted to place a band of fertilizer 2 inches to the side and 2 inches below the seed, while the other opener placed the band 4 inches lower than the upper band. This deeper fertilizer band was placed near the limit of penetration of the 18-inch diameter coulter.

OPERATIONAL OBSERVATIONS

Applications up to 1,000 pounds of fertilizer per acre, with a 40-inch row spacing, were made. Coulter scrapers are necessary to prevent soil from blocking the fertilizer passages when the opener is used in soils which adhere to the coulter.

Power requirements were slightly increased when the rolling coulter penetrated the plow sole in the heavy Brookston soils. No difficulty

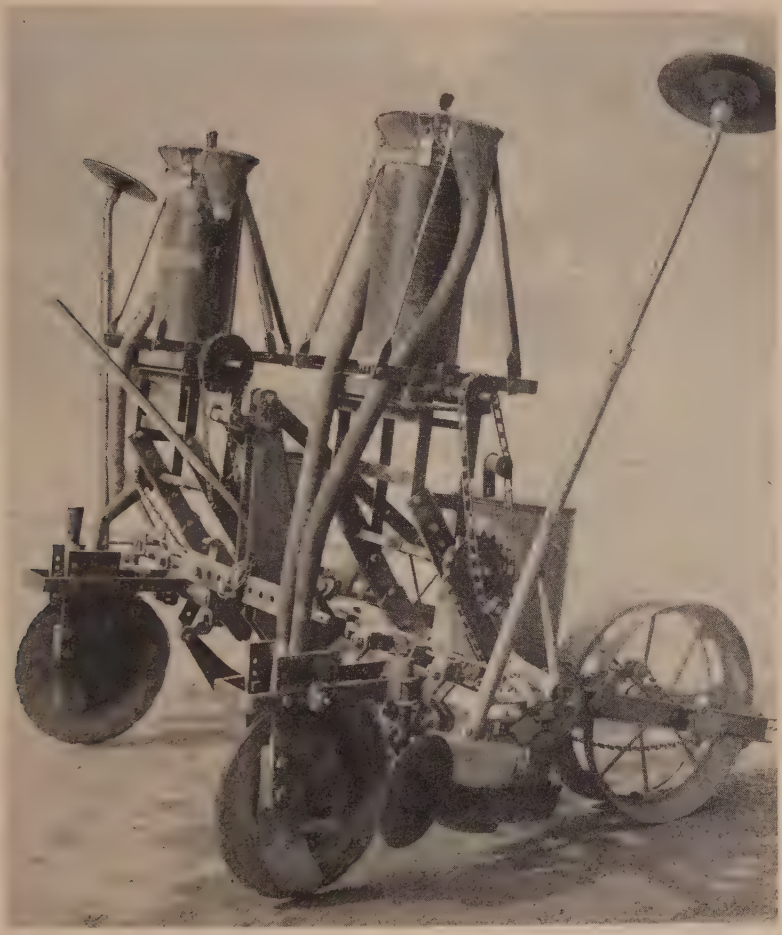

Fig. 1. Equipment used to place fertilizer in bands at two levels ahead of the corn planter.

was encountered when the opener was used in plowed-down corn stover.

FIELD RESULTS

In 1953 a randomized block corn experiment, replicated five times, was designed to compare yields obtained when using the rolling coulter furrow opener with yields obtained from a single band placed near the seed. The rolling coulter furrow opener deposited one fourth of the total fertilizer applied in a band 2 inches to the side and 2 inches below the seed. The remaining three-fourths of the fertilizer was de-

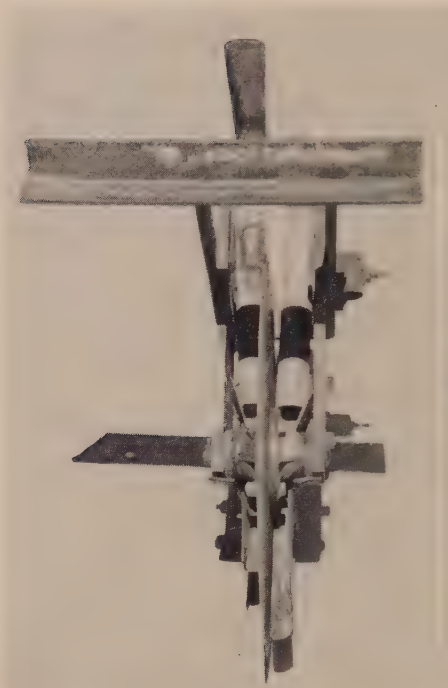

Fig. 2a. The saber-like furrow openers on each side of the rolling coulter which was used to deposit fertilizer at two levels (back view).

Fig. 2b. The low furrow opener deposits fertilizer at the depth of soil penetration. The high opener is located on the other side of the coulter and is adjusted to place fertilizer closer to corn seed.

*TABLE 2—Effect of fertilizer and fertilizer placement on corn yields**

Soil type	No fertilizer	Plowed down in spring	Single band 2 inches to the side and 2 inches below the seed	L. S. D.† at 5% level
	Bushels per acre			
Hillsdale sandy loam	32.4	45.2	59.7	4.9
Conover loam	53.1	57.2	58.5	N.S.
Conover loam	48.9	49.7	57.3	11.3
Average	44.8	50.7	58.5	....

*Data from Millar *et al* (1945). All fertilized plots received 500 pounds per acre of 8-8-8.
†Least Significant Difference.

posited in a second band 4 inches lower than the upper band. Three locations, one each in Calhoun, Ingham and Gratiot Counties, were selected for the corn tests. The two soil types, Fox sandy loam and Brookston loam, are representative of two major soil types used for corn production in Michigan. The corn was planted on May 20-25. Both the phosphorus and potassium levels of the two soils were markedly different (Table 3), but the differences showed little effect on the response obtained (Table 4). The corn yields in Calhoun County were low because of the drouth and the sandy nature of the soil.

The data in Table 4 present the results of the two methods of fertilizer placement. Paired data show an average increase of 4.4 and 5.1 bushels per acre in favor of the experimental rolling coulter opener in Calhoun and Ingham Counties, respectively, but a decrease of 2.0 bushels in Gratiot County. A statistical analysis of all 60 pairs of results showed 39 values to be positive for the experimental opener and 21 values negative. This gave a "t" value of 1.97. A value of 2.00 is necessary for significance at the 5-percent level.

FULL AMOUNT OF NITROGEN AT PLANTING TIME

The two-spout arrangement of the rolling coulter furrow opener made it possible to apply a 3-12-12 fertilizer through the high level furrow opener and ammonium sulfate (20 percent nitrogen) through the low level opener. Yields obtained when this equipment was used were slightly greater than those obtained when equal amounts of 3-12-12 were applied at planting time and a nitrogen sidedress on July 1. These results indicate that it is possible to apply the necessary plant nutrients at planting time, thus eliminating the costs of labor and machinery for an additional sidedressing operation (Table 5).

CONCLUSIONS

1. Plant nutrients applied at planting time at two levels below the corn seed yielded 3.8 bushels per acre more corn than equivalent amounts applied in two operations, one at planting time and one later as a sidedress.

2. Corn fertilized with the rolling coulter opener outyielded corn fertilized in a single band by 2.5 bushels per acre.

TABLE 3—Location, crop, soil and weather data of experiments reported in Table 4

	County		
	Calhoun	Ingham	Gratiot
Soil type	Fox sandy loam	Brookston loam	Brookston loam
pH	5.9	6.7	7.2
Phosphorus (reserve), pounds per acre	15 (low)	50 (good)	38 (medium)
Potassium (reserve), pounds per acre	90 (low)	210 (good)	104 (medium)
Preceding crop	Wheat stubble; some clover	Corn	Pickles
Temperature—June, July August	Above normal 0.1°F. per day	Above normal 1.9°F. per day	Above normal 1.7°F. per day
Rainfall	Very dry in July and late August. Normal early August	Heavy in June. Adequate in July and August	Deficient in June; normal in July and August
Population per acre (drilled corn)	12,000	15,000	14,000
Corn yield—no fertilizer, bushels per acre	35.7	97.1	90.7

TABLE 4—The effect of fertilizer placement on corn yield in Calhoun, Ingham, and Gratiot Counties in 1953

Treatment		County					
		Calhoun		Ingham		Gratiot	
Fertilizer	Pounds per acre	Band *	Rolling coulter†	Band *	Rolling coulter‡	Band *	Rolling coulter†
		Bushels per acre					
3-12-12	400	46.2	48.7	102.0	109.1	105.3	100.4
3-12-12 and nitrogen sidedress‡	400	45.0	45.8	116.5	120.4	107.0	105.7
10-10-10	480	43.4	48.4	117.8	124.6	110.9	114.7
10-10-10 and nitrogen sidedress‡	480	40.0	49.3	126.9	129.5	115.8	110.3
Average difference			+4.4	.....	+5.1	.....	−2.0
"t" value			2.15	.....	2.36	.....	1.67
"t" value necessary at 5% level			2.09	.....	2.09	.....	2.09

*Single-band fertilizer placement 2 inches to the side and 2 inches below the seed.

†Rolling coulter furrow opener. One-quarter of fertilizer placed in a band 2 inches to the side and 2 inches below the seed and ¾ of fertilizer 4 inches below the upper band.

‡Nitrogen sidedress July 1, 40 pounds of actual nitrogen applied.

TABLE 5—Effect of fertilizer and methods of placement of nitrogen on corn yields in Calhoun, Ingham, and Gratiot Counties, 1953

Fertilizer placement	County		
	Calhoun	Ingham	Gratiot
	Bushels per acre		
No fertilizer	35.7	97.1	90.7
3-12-12 (400) plus nitrogen sidedressing*	45.0	116.5	107.0
3-12-12 (400) plus nitrogen deep†	46.4	122.8	110.8
L. S. D 5%	7.9	10.7	12.9

*3-12-12 applied 2 inches to the side and 2 inches below seed plus 40 pounds per acre of nitrogen applied July 1.

†3-12-12 applied 2 inches to the side and 2 inches below seed with upper furrow opener and 40 pounds per acre of nitrogen applied with the lower opener. This complete application was made at planting time.

3. Some additional horsepower is required to pull the planter equipped with the rolling coulter furrow openers as compared with the conventional corn planter.

4. The design of the rolling coulter opener makes it possible to apply different fertilizers simultaneously at two different levels.

5. The use of a rolling coulter opener can eliminate the need for a sidedress application later in the season.

LITERATURE CITED

Anonymous (1953). Fertilizer Recommendations for Michigan Crops. Mich. Ext. Bul. 159.

Cook, R. L. (1951). Structure and sandy soils. Jour. Soil and Water Conservation, 6: 31-34.

Millar, C. E. *et al.* (1945). A method of comparison of applying fertilizer. Proc. of the National Joint Comm. on Fert. Application, pp. 99-103.

Millar, C. E. *et al.* (1947). The effect of fertilizer placement on the yield and maturity date of corn. Proc. of the National Joint Comm. on Fert. Application, pp. 129-133.

Millar, C. E. *et al.* (1948). The effect of fertilizer placement on the yield and maturity date of corn. Proc. of the National Joint Comm. on Fert. Application, pp. 51-54.

Turk, L. M. *et al.* (1949). The effect of fertilizer placement on the yield of corn. Proc. of the National Joint Comm. on Fert. Application, pp. 91-93.

AGRICULTURAL CONSERVATION PAYMENTS AND FARM PRACTICES

By LUTHER PICKREL and D. E. HATHAWAY
DEPARTMENT OF AGRICULTURAL ECONOMICS

THE FIELD OF CONSERVATION is perhaps one of the most delicate and complex problems to be faced in agricultural policy. Since the crusading days of Theodore Roosevelt, those working and writing in the field have encountered a profusion of conflicts and moral issues on every facet of the problem — from definition to execution. Not the least controversial of these facets has been the conservation payments made by the government. These payments are an outgrowth of a Supreme Court ruling of January 1936, which voided the Agricultural Adjustment Act of 1933 and led to the enactment of the Soil Conservation and Domestic Allotment Act of that year, followed by the Agricultural Adjustment Act of 1938. In addition to the production adjustment features, this later act provided for soil conservation payments to farmers for carrying out specified soil-conserving practices.

If one accepts the idea that conservation is a part of the general production process leading to a more efficient use of resources, the case for public policy in this field soon becomes apparent. The principal users of our land resources, farmers, do not always follow practices which result in optimum allocation of these resources over time. There are several reasons for this:

1. Lack of knowledge. Our system of education and information has not yet reached such a state of perfection that farmers always know the best techniques and methods.

2. Uncertainty as to future prices, yields, markets and tenure.

3. Lack of financial resources necessary to carry out conservation practices.

4. Conflicts in what is best for the individual and what is best for society.

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Thus, one cannot say that if a conservation practice is "profitable" a farmer will carry it out. Nor can one say that because a practice is "profitable" a farmer should carry it out with his own resources, and without aid or assistance from the government. In order for these assumptions to be valid it would be necessary to assume perfect knowledge and that individual and social welfare are synonymous.

In 1945 the production and conservation programs were organized under the Production and Marketing Administration (P. M. A.), and soil conservation payments were made under the Agricultural Conservation Program (A. C. P.). The worth and desirability of these payments have frequently been challenged.

According to the Agricultural Conservation Programs Branch of the P. M. A., the more important of the guiding principles followed in the administration of the program are: 1) Include only those practices that are badly needed. 2) Include only practices that most farmers cannot or will not do without public help. Attempt to buy more conservation with each dollar. 3) Pay from public funds only that part of the cost of each practice that has to be paid to get it done. Share the cost of conservation with the farmer, but be thrifty about it. 4) Give each state freedom to do what its farms need most. 5) Combine the best in practice and science with the cooperation of farmer committeemen and specialists[1].

This pilot study was made in an attempt to evaluate the success of the program in meeting these objectives. An analysis was made in Lenawee County, Michigan, of 35 farms which had participated in the farm management record-keeping project for a period of 5 years or longer. Lenawee County was chosen for two reasons: 1) It is a good productive farming county, and 2) it was the county with the largest number of record keepers in the farm management record-keeping project who had participated 5 years or longer. This was desirable because some had thought that there was a possibility that farm management records might be used in conjunction with Production and Marketing Administration records to analyze the effects of the A. C. P. payments on farm practices.

GENERAL BACKGROUND OF THE AGRICULTURAL CONSERVATION PAYMENTS

The Agricultural Conservation Program had at its disposal about $250,000,000 for the United States in each of the years that were

[1] *Agricultural Conservation Program, National Practices*, U.S.D.A., P. M. A., 1949, page iii.

TABLE 1—Agricultural conservation program participation and estimated gross assistance, Michigan and U. S., 1947-51

Program year	Number of participating farms (thousands)		Percent participation		Average gross assistance/payee (dollars)		Estimated gross assistance* ($ million)	
	U. S.	Mich.	U. S.	Mich.	U. S.	Mich.	U. S.	Mich.
1947	2,730	104	†	†	81	58	245	6.9
1948	2,296	81	40	41	50	33	124	2.9
1949	2,587	95	45	47	79	52	224	5.4
1950	2,577	101	46	51	89	57	252	6.3
1951	2,357	91	43	49	96	61	246	6.1

*This is not exactly equal to average gross assistance/payee times number of participating farms because more individuals received payments than there were participating farms.

†Not available.

TABLE 2—Distribution of farms participating in Agricultural Conservation Program by size of group and payments received, 1950

	0.1 to 10 acres	10.1 to 20	20.1 to 60 acres	60.1 to 100	100.1 to 220	220.1 to 420	420.1 to 860	860.1 to 1700	1700.1 to 4700
Estimated number of farms									
Mich.	1,102	2,909	22,093	32,757	33,574	6,981	1,000	139	27
U. S.	55,276	79,996	415,704	524,947	884,692	363,133	154,236	57,565	35,837
Estimated gross assistance per farm, in dollars									
Mich.	17.48	25.88	36.51	52.10	75.30	120.83	203.88	535.30	524.62
U. S.	20.33	28.24	41.00	57.63	84.82	135.21	208.94	336.04	524.14
Estimated gross assistance per acre, in dollars									
Mich.	3.03	1.80	0.95	0.68	0.49	0.39	0.33	0.27	0.11
U. S.	3.68	2.05	1.11	.71	.57	.46	.36	.30	.19

studied with the exception of 1948, when the appropriation was cut approximately in half (Table 1). During this same time Michigan's share of these payments amounted to between $5½ to 7 million annually, with the exception of 1948, when it was cut to something less than $3 million. During the 5-year period, the percentage of Michigan farmers participating was slightly higher than the national average, with about one-half of the Michigan farmers taking part in most of the later years. At the same time, the average gross assistance per payee in Michigan was approximately one-third lower than the U. S. average. When the recipients are broken down by farm-size groups, Michigan farmers were again below the U. S. average in both the average assistance per acre and assistance per farm (Table 2).

During the period studied, the percentage of payments for the different conservation practices in Michigan fluctuated. For instance, the share of total payments going for inorganic materials ranged from 58 percent in 1947 to 47 percent in 1948, 1950 and 1951. On the other hand, the share of the total which was paid for protective and green manure crops rose from 10 percent in 1947 to 29 percent in 1950, and to 27 percent in 1951. Payments made for drainage amounted to 13 percent of the total in 1947, 25 percent in 1948, and 16 percent in 1951 (Table 3).

TABLE 3—Summary of major Agricultural Conservation Program payments for Michigan, 1947-51

Practices	Percentage of total annual payments				
	1947	1948	1949	1950	1951
Total inorganic materials	58	47	54	47	47
Protective and green manure crops	10	16	18	29	27
Drainage	13	25	19	12	16

THE IMPORTANCE OF A.C.P. PAYMENTS TO FARM INCOME

The agricultural conservation payments have never been very large in relation to the gross farm income at any one time (Table 4). There is also some indication from Table 4 that the payments have tended to be larger percentage-wise in those states which have lower incomes, probably because the payments are largely on a per acre basis. How-

TABLE 4—Importance of A. C. P. payments relative to gross farm income in Michigan as compared with those in four other states

	Percent A. C. P. payments were of gross farm income			
	1950	1949	1948	1947
Michigan	0.8	0.2	0.3	0.8
Wisconsin	.7	.7	.3	.7
Indiana	.6	.5	.3	.6
Iowa	.5	.4	.2	.4
Georgia	1.3	1.3	.5	.9

ever, indications are that, in general, the payments occupy about the same position in relation to gross farm income in Michigan as in other midwestern states.

In order to determine the nature and importance of these payments to the individual farm, the records of the 35 farmers were carefully examined for the period 1947-51. The yearly A. C. P. payment for each farm account record was recorded and then compared with the crop income, crop expense, and the net farm income for the respective years. Later the A. C. P. payments as listed in the farm account record were compared with those of the county P. M. A. office. The latter were used in the compilation of the final figures since there were some discrepancies between the two, and it was thought that the P. M. A. records were probably the more accurate in this respect. In case no payment was received by a farm for a specific year, that farm was dropped from observation and was not included in the averages. In general, however, A. C. P. payments made up a fairly substantial percentage of the crop expense[2] and the crop income[3] on these farms for some of the years (Table 5). However, in no year did the A. C. P. payment average more than 3 percent of net farm income.

But Table 5 gives only a part of the picture. Of the 28 farms in the group which received payments in 1947, for instance, the payments to one farm amounted to 84 percent of its crop income; for another, 37 percent; and for three others, 23 to 29 percent. For 1951, five farms received A. C. P. payments totaling more than 23 percent of their crop income. These payments amounted to 14 percent or more of the crop expenses on almost half of the farms in the sample group in 1947. Of the participating farms in the sample, only five received payments

[2]Crop expense included only direct cash expenses and included no charge for machinery, interest on investment, land, etc.
[3]Crop income was computed from cash sales and changes in crop inventory.

TABLE 5—Relative importance of A. C. P. payments on 35 farms studied in Lenawee County, Michigan

Year	Percent A. C. P. payment was of crop income	Percent A. C. P. payment was of crop expense	Percent A. C. P. payment was of net farm income
1947	9.6	11.3	2.2
1948	3.3	5.3	1.3
1949	5.4	9.0	2.7
1950	7.0	11.0	2.0
1951	9.4	11.0	2.2

which totaled less than 10 percent of the crop expense for 1951. Payments to seven of the farms amounted to 5 percent or more of the net farm income in 1949. On one farm, A. C. P. payments amounted to 16 percent of the net farm income in 1949. Thus, it seems that while the payments have not loomed large on the average in relation to net farm income, for individual farmers and for certain years these payments have certainly become a substantial portion of the out-of-pocket crop expense, and they made up a fairly substantial portion of crop income for farmers in this area.

THE PATTERN OF PAYMENTS

The Production and Marketing Administration emphasizes that A. C. P. payments are to go to farmers to help pay for those practices which farmers could not otherwise afford to carry out. However, the history of the program in Michigan shows that payments for liming and green manuring practices constitute a large share of the total A. C. P. payments made in the state. This suggests that perhaps these payments are viewed as an educational medium through which the farmer can be introduced to the use of these practices. No attempt will be made to contest the merits of this approach. But if that is true, it would follow that after the farmer had received payments for a new practice, he would then be dropped from the role of a payee for that particular practice in following years. However, among the 35 farms studied in this sample, 27 received payment for liming during the 5-year period.

Only five, or 14 percent, of the group received payment for liming in just one out of five years (Table 6), while more than half, 52 percent, received payment for liming in two or more years. Twenty-nine

TABLE 6—Number of farmers paid for liming and green manuring during 5-year period, 1947-51

Payments received	Liming		Green manuring	
	Number of farms	Percent total farms	Number of farms	Percent total farms
5 out of 5 years.....	2	6	0	0
4 out of 5 years.....	3	9	5	14
3 out of 5 years.....	5	14	3	9
2 out of 5 years.....	8	23	11	31
1 out of 5 years.....	5	14	8	23
0 out of 5 years.....	12	34	8	23
Total.....	35	100	35	100

percent received payment for this practice in three or more years, 15 percent in four or more, and 6 percent received payments in each of the five years studied. Essentially the same pattern can be observed for payments for green manuring (Table 6), except that no farmer received payment for this practice in all of the five years studied.

It is doubtful if any farm management specialist would claim that liming or the use of green manure are practices which the farmer cannot afford to carry out by himself, or that they are the type of conservation which the government must share with the farmer every year. The real question is: Do these practices make a profitable contribution to the general welfare and, if so, do the payments motivate farmers to carry them out more extensively, or are the farmers merely being paid for practices which they would normally follow?

An analysis was attempted of the pattern of the use of lime and of green manuring practices on the farms receiving A. C. P. payments and those not receiving them. But, in the small sample studied it was not possible to draw conclusions. Among the 12 farms in the sample which received no A. C. P. payments for lime applications during the period studied, seven applied no lime at all, three applied lime during one of the five years, and two for two years.

Table 7 indicates that there may be some relationship between A. C. P. payments and lime applications. Only 3 percent of the farms in the sample group were limed without A. C. P. assistance in 1947, while 40 percent of the group received assistance for liming. This assistance was given for 91 percent of the total tons of lime applied. In 1948, when appropriations were cut, the percentage of those liming

TABLE 7—A. C. P. payments for application of lime on 35 sample farms, 1947-51

	1947	1948	1949	1950	1951
Percent of farms on which liming was done with no P. M. A. assistance.....	3	14	14	6	3
Percent of farms receiving P. M. A. assistance for liming.....	40	46	29	31	20
Percent of total tons of lime applied for which P. M. A. assistance was received.	91	69	57	79	89

without assistance increased more than four times to 14 percent, but the percentage of tons applied for which assistance was given dropped from 91 to 69 percent.[4] In 1949, when most of the reduction of the previous year was restored, those liming without assistance remained at 14 percent and the percentage of total tons applied for which assistance was received fell still further to 57 percent.

However, by 1950, when the purchasing power of farm products had fallen below an index of 100, the number of farmers liming without assistance dropped to 6 percent and then again to 3 percent in 1951. The percentage of farms receiving assistance was also down, but the percentage of tons applied for which assistance was given rose sharply during those two years.

Further, if one compares the data in Fig. 1 and Tables 7 and 8, he will note that, generally, as the A. C. P. assistance for liming decreases the number of tons applied also decreases. Just how much of this is a cause-effect relationship, and how much may be due to the farmer's having decided that his lime needs are satisfied cannot be determined from this limited study. However, the case for the former takes on considerable significance when one considers the general need of the soils in Michigan for lime. According to the best information available,[5] farmers in the state have applied only about 8 million tons of lime during the last 16 years. Used at a rate of 2 tons per acre, this would have covered 4 million of the 8 million acres of the lime-deficient soils, leaving 4 million acres still unlimed. If, during the next 10 years, farmers were to lime at the rate of 2 tons per acre the 4 million acres

[4]In the sample group the percentage of farms receiving assistance increased slightly, but this was contrary to the state trend, which was down. See Table 8.

[5]Unpublished data made available by Prof. E. D. Longnecker, Soil Science Department, Michigan State College, September 1953.

TABLE 8—Liming materials, standard ground limestone equivalent, applied for conservation uses under the Agricultural Conservation Program, Michigan 1947-51

Year	Counties (number)	Farms (number)	Total amount applied (tons)	Average amount per acre (tons)	Total average area treated (acres)	Average cost per ton (dollars)	Total (dollars)	Portion of state total (percent)
1947.....	81	37,427	904,828	2.0	457,151	2.14	1,936,463	27
1948.....	82	32,116	708,067	1.9	368,291	1.67	1,182,383	24
1949.....	82	32,000	688,358	2.0	243,997	1.78	1,227,483	20
1950.....	83	23,568	525,335	2.0	260,840	1.73	907,700	14
1951.....	81	21,418	525,115	2.0	265,231	1.81	949,746	15

Fig. 1. Tons of lime purchased annually in Michigan 1935-52.[6]

yet unlimed, and apply a mere maintenance quantity (200 pounds per acre annually) to the 4 million acres limed during the past 16 years, it would require 1.2 million tons per year or about twice the current rate.

A somewhat different pattern appears for green manuring practices on the 35 farms that were studied (Table 9). Here, the percentage of farms that carried out green manuring (according to their farm management records) without P. M. A. assistance, jumped rather sharply in 1948 when the appropriations were cut. However, this figure has increased each year since that time. The percentage of farms receiving assistance for green manuring also dropped sharply from 1947 to 1948. The 1948 figure was about one-third less than that of the previous year and less than any of the following years, which indicates again that a number of farms were carrying out green manuring practices without the aid of A. C. P. payments. It should also be noted that the percentage of farms on which green manuring was done with no A. C. P. payments rose steadily from 1947 through 1951. Although the number of farms receiving assistance decreased by only one-third from 1947 to 1948, the total acreage for which assistance was given decreased by about one-half. In this case it is difficult to attribute any direct influence of A. C. P. payments to green manuring practices carried out.

This study, of course, does not answer the question of whether

[6]Hoglund, C. R. (1953). *Farmers progress problems and adjustments in adopting conservation practices.* Mich. State Coll., Agr. Econ. Dept., Mimeo Pub., Unnumbered, May 8.

TABLE 9—A. C. P. payments made for green manuring practices on 35 sample farms, 1947-51

	1947	1948	1949	1950	1951
Percent of farms on which green manuring was done with no P. M. A. assistance	17	29	31	34	46
Percent of farms receiving P. M. A. assistance for green manuring	37	26	40	37	29
Percent of total acres green manure for which P. M. A. assistance was given	58	31	46	58	24

P. M. A. payments are important factors determining the practices that a farmer carries out on his farm. There is some indication, however, that in the years when the purchasing power of farm products is relatively low and money is "tight" considerably less liming will be done without subsidy than if assistance is available. Green manuring practices, on the other hand, do not appear to be influenced appreciably. Estimates by Michigan soil science specialists[7] suggest that when lime is applied as recommended to land with a pH test of below 6.3, the average return for an investment in lime is about 8 to 1. When applied as recommended, average returns for fertilizer are about 3 to 1. Yet, fertilizer consumption increased about three-fold from 1940 to 1951, while lime consumption was not even doubled during the same period. There are perhaps two contributing factors responsible for this: 1) Greater activity on the part of commercial fertilizer distributors, and 2) return for investment in fertilizer is largely realized the following year while that for lime is spread over approximately 10 years. It is also more difficult to measure results in terms of more hay and pasture.

There is some indication also that in years in which the payments for specific practices were reduced rather drastically there was some reduction in the total amount of these practices carried out, and there was a rather sharp reduction in the percentage of farms that received payments for these practices. This indicates that perhaps part of the farmers would carry on these practices regardless of the A. C. P. payments, and that another portion of the farmers would not normally carry on these practices at the same rate but are actually encouraged to do them by the A. C. P. payments. It seems that the Department

[7]See footnote[5].

of Agriculture is tending to decrease cost sharing of lime applications, since this is generally regarded as a profitable production practice. Their estimates as to its value are in agreement with those of M. S. C. soil specialists. However, in the absence of a government cost sharing program, indications are that the rate of liming may drop further below a desirable level on many farms unless an intensified educational program regarding the value of lime can increase farmers' incentive to use it.

Certainly further study and analysis should be made to determine if these indications are true on a widespread basis.

JOURNAL ARTICLE ABSTRACTS

The Protein Content of Fresh and Stored Shell Eggs

Evans, Robert J., and J. A. Davidson

Poultry Sci. 32: 1088-1089. 1953 (Journal Article 1028 from the Michigan Agricultural Experiment Station)

Eggs from six Single-comb White Leghorn hens, fed diets of constant composition, were stored for 9 and 18 months at 0° C. Protein preparations from both fresh and stored eggs were made and analyzed for crude protein (N x 6.25). There were no losses of protein from stored shell eggs during 18 months of storage.

Corn Syrup Wins Place as Pickle Sweetener

Fabian, F. W., and Hilliard Pivnick

Food Eng. 25: 97, 98, 138, 140. 1953 (Journal Article 1305 from the Michigan Agricultural Experiment Station)

Different kinds of sweet pickles were made with sweetose and different combinations of sweetose and sucrose, using standard formulas. The products were then subjected to a consumer taste panel, consisting of 294 students ranging in age from 25 to 27 years and who were from 28 states and foreign countries. Conclusions reached from an analysis of the data are:

1. In low Baumé sweet pickles, 15 percent of the sucrose may be replaced with sweetose without any effect on consumer acceptance.

2. Standard Baumé sweet pickles can be made with 15 percent of the sweetener as sweetose when the acetic acid content is decreased by about one grain of acid. In some instances, this small decrease in acid content might necessitate pasteurization of the finished product to insure against spoilage in some factories.

3. High Baumé pickles can be made with 50 percent of the sweetener present as sweetose, but any greater amount of substitution may lead to a low acceptance of the product.

4. Fresh cucumber pickles of the bread-and-butter type, made with 25 percent sweetose substituted for sucrose, were not so acceptable as those made entirely with sucrose.

Comparative Stimulation of Parthenocarpy in the Tomato by Various Indole Compounds

Sell, H. M.; S. H. Wittwer, T. L. Rebstock and C. T. Redemann

Plant Physiol. 28: 481-487. 1953 (Journal Article 1385 from the Michigan Agricultural Experiment Station)

The efficiency of the ethylindole-3-acetate and other indole compounds to promote fruit-setting in tomatoes was studied. Compounds active in a 0.01 percent solution of lanolin were methylindole-3-acetate, ethylindole-3-acetate, n-butylindole-3-acetate, n-amylindole-3-acetate, 4-chloroindole-3-acetic acid, 5-chloroindole-

3-acetic acid, 6-chloroindole-3-acetic acid, 7-chloroindole-3-acetic acid, ethyl-5-chloroindole-3-acetate and indole-3-butyric acid. At 0.001 percent, only the methyl and ethyl ester of indole-3-acetic acid stimulated parthenocarpy in the tomato. Previously it was reported that ethylindole-3-acetate was 100 times more effective than the free acid. Further work has confirmed this observation and has also demonstrated that the chloro-indole acetic acids are one-tenth as effective as the ethylindole-3-acetate. Esterification of the chloroindole-3-acetic acids did not increase the activity as it does in the case of indole-3-acetic acid. The activity of the esters of indole-3-acetic acid decreases as the size of the ester radical is increased, with the exception of the methyl and ethyl esters which have identical activity. The introduction of a radical (methyl or phenyl) on the indole nucleus in the 2-position greatly reduced the activity, and all activity disappeared if both positions ortho to the alkyl sidechain were occupied.

The Fat-Globule Membrane of Nonhomogenized and Homogenized Milk. I. The Isolation and Amino Acid Composition of the Fat-Membrane Proteins

BRUNNER, J. R.; C. W. DUNCAN AND G. M. TROUT

Food Res. 18: 454-462. 1953 (Journal Article 1398 from the Michigan Agricultural Experiment Station)

Fat-membrane materials were concentrated from nonhomogenized milk by a washing-dilution technique. The fat-membrane proteins were obtained by treating the concentrate with a cold alcohol-ethyl ether extraction to remove the lipoid materials. The concentration of total protein per gram of fat was greater in the washed cream from homogenized milk.

Microbiological assays for the essential amino acids, glutamic acid, cystine, and glycine in the fat-membrane protein of nonhomogenized milk and homogenized milk demonstrated a material increase in concentration of lysine and glutamic acid and a marked decrease in the concentration of tryptophan, cystine, and glycine in the fat-membrane proteins of homogenized milk. These differences in amino acid composition indicate that the main protein constituents of the milk plasma form a large percentage of the membrane-protein complex in homogenized milk.

Inhibition of Runner Plants in the Strawberry (Fragaria spp.) by Chemical Treatment

CARLSON, R. F.

Proc. Am. Soc. Hort. Sci. 61: 201-217. 1953 (Journal Article 1399 from the Michigan Agricultural Experiment Station)

Many of the horticultural strawberry varieties have a tendency to produce a superabundance of runner plants, thus creating a need for thinning and spacing by manual methods. Inhibiting runner formation by chemical treatment seemed logical for the elimination of excess runner plants.

The strawberry runners were inhibited most when a certain chemical was applied twice at the time of runner initiation. Dichloral urea, phenoxyethyl trichloroacetate and 2,4-dichlorophenoxyacetic acid were most effective in reducing runner formation, whereas isopropyl N-phenylcarbamate and maleic hydrazide were less effective, depending on the concentration used. The compound 2,4-

dichlorophenoxyethyl sulfate did not significantly inhibit any runners from plants either in the greenhouse or in the field. The amount of inhibition under greenhouse conditions ranged from 10 to 80 percent, depending on variety and concentration. In the field the percentage of inhibition was greater.

Influence of Temperature on the Flowering and Calyx Splitting of Greenhouse Carnations

HALLIDAY, WILLIAM G., AND DONALD P. WATSON

Proc. Am. Soc. Hort. Sci. 61: 538-542. 1953 (Journal Article 1400 from the Michigan Agricultural Experiment Station)

Temperature has a considerable effect upon the growth and splitting of the calyx of carnation flowers. In the work reported, a night temperature of 60° F. resulted in greater production and less splitting of calyces—but of poorer quality—than did the 50° F. night temperature. At 40° F. night temperature, production was greatly decreased, but calyx splitting was increased. There was a marked difference in varietal response to temperature. If once a month the temperature is lowered 10 to 15° F. below the night temperature usually used, production will greatly decrease and splitting increase.

The number of petals in a flower with a split calyx is usually greater than in a normal flower of the same variety from the same plot. Splitting of the calyx cup seems to be caused by mechanical pressure inside the calyx.

The Effect of Light Intensity on Flowering Tendency of Chrysanthemum morifolium Bailey

WATSON, DONALD P., AND PAUL S. ANDREWS

Proc. Am. Soc. Hort. Sci. 61: 551-554. 1953 (Journal Article 1401 from the Michigan Agricultural Experiment Station)

It is apparent that plants of the chrysanthemum variety Gold Coast will initiate flower buds when grown under a maximum light intensity of 1000 foot candles, but under such light they require more than twice as long for initiation to occur as compared with others under normal daylight.

The Fat-Globule Membrane of Nonhomogenized and Homogenized Milk. II. An Electrophoretic Characterization of the Fat-Membrane Protein

BRUNNER, J. R.; H. A. LELLEVIK, G. M. TROUT AND C. W. DUNCAN

Food Res. 18: 463-468. 1953 (Journal Article 1403 from the Michigan Agricultural Experiment Station)

Ascending and descending electrophoretic mobility patterns are reported for the fat-membrane proteins prepared from the washed cream concentrates of nonhomogenized and homogenized milk by cold alcohol-ether extraction. Five buffer systems were observed: glycine-HCL, pH 1.5; phosphate, pH 6.5; veronal-citrate, pH 8.0; ammonia-HCL, pH 9.0; veronal-ethyl-amine, pH 10.8. Generally, one to three components were observed in the nonhomogenized fat-membrane proteins,

whereas two to four components of different electrophoretic characteristics were observed in homogenized fat-membrane proteins. No identification of these components was attempted.

Pectolytic Enzymes of Garlic

MISEKOW, ROBERT W., AND F. W. FABIAN

Food Res. 18: 1-5. 1953 (Journal Article 1413 from the Michigan Agricultural Experiment Station)

Garlic was found to contain pectinesterase in amounts of 0.156×10^{-2} to 0.114×10^{-2} PE units/ml., depending on the amount of extract used. Garlic pectinesterase showed decreased activity at 3.0 and 3.7 percent NaCl and at pH 4, which is the amount of salt and acid commonly found in dill pickles. Pectinesterase was also found in powdered garlic and garlic flakes but showed only approximately one-fourth the activity of the fresh garlic buds. Pectinesterase was inactivated in 5 minutes at 72° C. It would be destroyed in pasteurized pickles since they are pasteurized at 72° C. (165° F.) for 15 minutes.

Polygalacturonase-like enzymes could not be demonstrated in either fresh or dehydrated garlic products. A polygalacturonase-like enzyme was found in all samples of naturally decomposed garlic buds and in garlic decomposed by *Penicillium canescens* but not in garlic decomposed by *Fusarium oxysporum*, which indicates that not all molds which depose garlic produce this enzyme.

The Fat-Globule Membrane of Nonhomogenized and Homogenized Milk. III. The Characterization of the Fat-Membrane Proteins by Ultracentrifugal Studies

BRUNNER, J. R.; G. M. TROUT, C. W. DUNCAN AND MAXIME MACKENZIE

Food Res. 18: 469-474. 1953 (Journal Article 1417 from the Michigan Agricultural Experiment Station)

Ultracentrifugal sedimentation-velocity diagrams for the fat-membrane proteins of nonhomogenized and homogenized milk in veronal-citrate buffer at pH 8.0 are reported. Sedimentation diagrams show one principal component in the fat-membrane protein preparation of nonhomogenized milk, whereas three components and possibly one of lower concentration and mobility were detected in the fat-membrane proteins of homogenized milk. The fat-membrane protein was classified provisionally as lactoglobulin or as a protein of globulin-like nature. The proteins which constitute the adsorbed proteins in homogenized milk were classified previously as casein, Kekwick's whey-protein, and a complex of lactoglobulin, B-lactoglobulin or two or more of the constitutent milk protein.

The Cause of Cloudiness in Pickle Brines

FABIAN, F. W., AND M. N. KRAGT

The Canner: 116 (12), 9-10, 18-27; (13), 10-11, 17; (17), 13-14, 18. 1953 (Journal Article 1418 from the Michigan Agricultural Experiment Station)

A bacteriological, chemical and physical study was made of the factors causing cloudiness in the dill and sweet type of pickles made from fresh and salt

stock cucumbers. Many factors were found which may cause cloudiness. In respect to chemical factors, pH, electrolytes, isoelectric points, anions and cations may be involved, which acting together or separately may cause cloudiness. Physically, heat causes cloudiness in certain brines by coagulation and precipitation of certain substances such as proteins. Bacteriologically, cloudiness may be due to the growth of a certain acid-tolerant bacteria. Isolation and study of the predominant bacteria showed them to be *Lactobacillus* of the species *plantarum* and *fermenti*.

Urease and Catalase Activities of *Brucella melitensis* from Different Geographical Regions

SANDERS, EVELYN, AND JUANITA WARNER

Amer. Jour. Vet. Res. 14: 388-391. 1953 (Journal Article 1421 from the Michigan Agricultural Experiment Station)

The activities of urease and catalase in cells of smooth-intermediate colonial types of 84 strains of *Brucella melitensis* have been determined and compared. The strains showed wide differences in both urease and catalase activities. The high or low activities of each of the enzymes was characteristic of strains from certain limited geographical regions: 1) central and eastern United States—urease, 2.6 mg. urea decomposed; catalase, 47.2 ml. of 0.1 N H_2O_2; 2) France—urease, 3.9; catalase, 7.5; 3) Mediterranean Islands, North Africa, Turkey, Italy, Europe, South America, Mexico and southwestern United States—urease, 0.2; catalase, 10.9.

Strains of *Br. melitensis* showing high activities of both enzymes, urease and catalase, were isolated only in the central and eastern sections of the United States where infections by *Br. melitensis* had not been detected until recent years.

How Store Lights Fade Pickles

FABIAN, F. W., AND F. L. BALDWIN

Food Eng. 25: 61, 169, 171, 173. 1953 (Journal Article 1427 from the Michigan Agricultural Experiment Station)

In the experiments reported, six different types of lamps were used to determine the effect of fluorescent light on bleaching pickles. They were: G. E. 40-watt, 4-foot length lamps of the following types: soft white, standard, daylight, warm white deluxe, warm white, and the standard cool white.

It was found that all lamps caused definite bleaching at the end of 36 hours. In all tests, two lamps, the daylight and the standard cool white, consistently caused the earliest and greatest amount of bleaching, and the warm white deluxe caused the least amount.

Fresh pasteurized dill pickles seemed to be the most susceptible group of pickles to bleaching by fluorescent light. The ones most susceptible to bleaching were those containing 15 p. p. m. copper, 25 p. p. m. copper, 0.1 percent alum and tumeric. However, the batch which contained a combination of 15 p. p. m. copper, 0.1 percent alum and tumeric showed the least amount of bleaching. Sweet pickles containing the lowest concentration of sugar bleached most.

The Viability of Thermophilic Bacteria in the Presence of Varying Concentrations of Acids, Sodium Chloride and Sugars

FABIAN, F. W., AND H. D. GRAHAM

Food Tech. 7: 212-217. 1953 (Journal Article 1428 from the Michigan Agricultural Experiment Station)

A study was made of the influence of acids (acetic, citric and lactic), sodium chloride and sugars (dextrose, sucrose and frutose), on the viability of five representative cultures of thermophilic bacteria.

The order of effectiveness of the acids in terms of germicidal action was found to be citric > acetic > lactic. For sugars the order was found to be dextrose > frutose > sucrose. Concentrations of NaCl above 1.5 percent proved germicidal, while concentrations below 1.0 percent accelerated growth in some cases.

In all instances normal growth was observed to be very rapid, the maximum cell count being attained after about 8 hours. This exceptionally high growth rate was followed by a pronounced and rapid death rate, sterility of some cultures ensuing after 48 to 96 hours.

A New V-8 Medium for Determining Acid-Producing Bacteria

FABIAN, F. W.; R. C. FULDE AND J. E. MERRICK

Food Res. 18: 280-289. 1953 (Journal Article 1432 from the Michigan Agricultural Experiment Station)

A medium containing V-8 vegetable juice and brom cresol green (as an indicator) was compared with 10 other media that have been used for the detection of lactic acid bacteria, especially lactobacilli. It was found that the V-8 medium compared favorably with other media commonly used for determining *Lactobacillus*, *Leuconostoc*, *Streptococcus*, etc. The indicator inhibits slightly the total number of bacteria, but this disadvantage is offset by the ease with which the colonies may be identified. Most of the lactic acid bacteria give rise to a peculiar characteristic colony that seems to possess a differential character when cultivated on the V-8 medium. This new medium also seems to have the added advantage of inhibiting species of the genus *Bacillus*, *Micrococcus* and *Sarcina*, both surface and subsurface colonies—and possibly species of other genera—but only the above three named genera were actually studied. This in itself is a great advantage since it is desirable to incubate plates 2 to 5 days to determine *Lactobacillus* after which time, with most media used, many plates may be covered with spreaders.

The Influence of Soil Nutrients on the Growth of *Hyacinthus orientalis* Linn

AMIN, FOUAD Y., AND D. P. WATSON

Proc. Am. Soc. Hort. Sci. 61: 533-537. 1953 (Journal Article 1445 from the Michigan Agricultural Experiment Station)

This study of the effect of soil nutrients on the growth of hyacinth plants during the forcing period found that the kind and amount of nutrients influenced the time required for flowering, the length of the flowering period, and the quality of hyacinth plants grown in sand culture. The treatment that produced the earliest flowering, the longest flowering period, and the best quality of plants was

one which contained 100 p. p. m. each of nitrogen, potassium, and calcium; 50 p. p. m. of magnesium, 20 p. p. m. of phosphorus, and moderate levels of micro elements.

All plants grown in a nutrient solution produced more uniform growth than did those grown in distilled water. The highest degree of uniformity occurred in plants grown in a low-phosphorus concentration of 20 p. p. m. with moderate nutrient levels.

The Importance of Biotin, Niacin and Pantothenic Acid in Cucumber Fermentation

ROSEN, SAMUEL, AND F. W. FABIAN

Food Tech. 7: 244-247. 1953 (Journal Article 1449 from the Michigan Agricultural Experiment Station)

A study was made of the kind and number of microorganisms present during the fermentation of cucumbers salted at 30° salometer. All of the acid-producing bacteria isolated from three different fermentations, under laboratory conditions, were identified as *Lactobacillus plantarum. Aerobacter,* which predominated for a brief period at the beginning of the fermentation, were found to belong largely to the *cloacae* species. The yeasts found included *Hansenula, Rhodotorula, Debaryomyces, Torulospora rosei,* and *Torulopsis holmii.*

Cucumber juice extracted from eight varieties of cucumbers were assayed by microbiological methods and found to contain the following amounts of these vitamins: Biotin: 5.20 to 33.0 mμg./ml.; niacin: 1.83 to 5.05 μg./ml. and pantothenic acid: 1.05 to 2.42 μg./ml. The MR-17 variety of cucumber consistently contained the largest amount of these three vitamins.

It was found that *L. plantarum* required biotin, niacin and pantothenic acid. A study was also made of the effect of *A. cloacae* and the yeasts isolated from cucumber fermentations on the vitamin content of cucumber juice. It was found they a) had no effect on niacin, b) decreased the biotin, and c) increased the pantothenic acid content of cucumber juice; that an abundant supply of biotin, niacin, and pantothenic acid was available within 12 hours after brining; and after 20 days the niacin content remained unchanged, the pantothenic acid content increased, and the results were variable in respect to biotin.

Role of Biotin in Cucumber Fermentation

ROSEN, SAMUEL, AND F. W. FABIAN

Food Tech. 7: 242-244. 1953 (Journal Article 1450 from the Michigan Agricultural Experiment Station)

The role of biotin in the nutrition of *Lactobacillus plantarum* and *Aerobacter cloacae* was studied in an attempt to show the significance of biotin in cucumber fermentation. It was found that when *L. plantarum* grew in cucumber juice, the biotin content was reduced slightly. When *L. plantarum* grew in an assay medium containing biotin, the content of this vitamin was markedly depleted. Tween 80 was found to serve as a biotin substitute and seemed to "resist" reduction of biotin activity when subjected to growth by *L. plantarum.*

It was demonstrated that *A. cloacae* did not require biotin. This organism was shown to synthesize that vitamin if grown in an assay medium containing

small amounts of biotin-active substances. However, the biotin level was lowered when this vitamin was present in high concentrations. When grown in cucumber juice, even when diluted 1:20, *A. cloacae* reduced the biotin content.

Chemical and Physical Agents Producing Green Color in Pickles

WHEATON, R. D., AND F. W. FABIAN

The Canner 116: (20), 21-24; (22), 30-32. 1953 (Journal Article 1453 from the Michigan Agricultural Experiment Station)

Factors were studied in commercial pickle manufacture which would affect the green color of the finished product and, if possible, would restore the green color either wholly or in part once it had been lost.

The effect of metals was tested by using 1, 10, and 100 p. p. m. of 23 metallic ions in various salt, acid, and sugar concentrations normally found in commercially made pickles. Copper produced greenness in a concentration of 1 p. p. m. in a neutral solution and in a concentration of 3 p. p. m. in an acid solution. It was the only metal tested that did.

Sodium benzoate produced a greenness in pickles in a concentration of 5 percent in a neutral solution and of 4 percent in an acid solution.

Oil of pimento (allspice) was the only spice which produced a greenness in standard sweet pickles in heated sweet brine when added in a concentration of 1 part oil to 1000 parts pickles and liquor. Oil of garlic was found to cause a loss of green color in the pickles under the same conditions.

Pickles sweetened with d-glucose, d-frutose, and sucrose were darker in color than the controls. No color differences could be discerned among the pickles sweetened with the three sugars.

Four blanching treatments were studied, viz., boiling water, steam, boiling 0.005 M calcium hydroxide solution, and the latter treatment preceded by a 2-hour immersion at room temperature in a 2-percent sodium carbonate solution. Although no differences were noted among the four blanching treatments, the slices that received any one of the blanching treatments had a better color retention than did the unblanched controls.

Attempts to color pickles with two water-soluble chlorophyll products, viz., potassium magnesium chlorophyllin and sodium potassium copper chlorophyllin, were unsuccessful. These compounds readily colored the pickles in a basic but not in an acid solution.

Certain combinations of certified food colors were used to produce a satisfactory green color in bleached pickles. The best results were obtained when the color was fixed in the pickles during the presouring process by heating them in a solution of 0.2 percent aluminum sulfate ($Al_2(SO_{43}) \cdot 18H_20$) for 5 minutes at 165° F.

Factors Which Produce Bleaching of Pickles

EISENSTAT, LEON, AND F. W. FABIAN

The Glass Packer 32: (4), 29-31, 50, 78; (5), 44-46, 70, 72. 1953 (Journal Article 1457 from the Michigan Agricultural Experiment Station)

Dill pickles which were stored in jars bleached considerably when exposed to diffused light over a period of a month and one-half when compared with those

which were exposed for only a week. By contrast, salt stock pickles showed no color loss whatsoever over the long exposure period.

Of the different salts tested, calcium chloride, zinc acetate, and potassium dihydrogen phosphate caused marked bleaching of pickles. Temperatures ranging from 12° to 37° C. had little effect on the color. Salt concentration is not a factor, since the pickles with NaCl concentrations from 0.7 to 20 percent were all negative to color changes. Tests made with spice oils showed some conflicting results. In the main, however, the combination of spice oils as an emulsion, used in the manner employed in the pickle plant, yielded negative results. The use of oleoresin of tumeric yellowed and deepened the pickle color and favored color retention in the pickles, but its use did not, in any case, result in loss of pickle color.

In the experiments undertaken, these were the factors which resulted in bleaching pickles: direct sunlight, infrared rays, storage, alum, to a slight extent; vinegar, to a slight extent; ultraviolet rays, under certain conditions. It is obvious from the results reported that only a beginning has been made in exploring the problem of pickle bleaching.

Growth of Bacteria in Soluble Oil Emulsions

FABIAN, F. W., AND HILLIARD PIVNICK

Applied Microbiology 1: 199-203. 1953 (Journal Article 1467 from the Michigan Agricultural Experiment Station)

Oil concentration, different concentrations of peptone, several diluents and media were investigated to determine their effect on the growth of bacteria found in soluble oil emulsions gathered from various factories. Likewise, air, sputum, feces, sludge from a machine shop pit, sweepings from a machine shop floor and garden soil were added to soluble oil emulsions to test their influence on the bacterial plate count. M/20 phosphate buffers at pH 7.0 to 8.0 or distilled water was adequate as a diluent, and nutrient agar was the plating medium. Diluents containing sodium chloride were undesirable. Bacteria grew readily in a variety of soluble oils when the above-mentioned inocula were added to them. Increasing the oil concentration of the emulsion decreased the mean generation time and increased the number of viable bacteria. The addition of peptone increased the number of viable bacteria and also the objectionable odors in the soluble oil emulsions. Large bacterial populations are rarely encountered in soluble oils such as are found in milk, fish, soil, etc. Very low populations (10^3 to 10^4) in industrial samples usually indicate the presence of disinfectants.

Methods for Testing the Germicidal Value of Chemical Compounds for Disinfecting Soluble Oil Emulsions

PIVNICK, HILLIARD, AND F. W. FABIAN

Applied Microbiology 1: 204-207. 1953 (Journal Article 1469 from the Michigan Agricultural Experiment Station)

Two methods were developed for testing the efficacy of chemical compounds used as disinfectants in soluble oil emulsions. A large number of compounds were tested by the two methods. The methylene blue test as described proved

valuable as a screening test. A final and more severe test was to circulate the soluble oils over iron chips at a certain rate. Under the conditions of this test few chemical compounds proved to be of any value.

Electrophoretic Studies on the Serum Proteins of Turkeys. I. The Composition of Normal Turkey Serum

LYNCH, J. E., AND H. J. STAFSETH

Poultry Sci. 32: 1068-1073. 1953 (Journal Article 1477 from the Michigan Agricultural Experiment Station)

The purpose of this study was to investigate further the composition of normal turkey serum. It was the author's hope that this, in turn, might enable them to deal more intelligently with problems connected with the agglutination test for pullorum disease and other infections. The relative percentage composition and mobilities of the serum proteins were established for the conditions under which the experiment was conducted. Electrophoretic analyses of normal turkey serum gave the following results with respect to relative proportions of serum protein components: albumin 66.5 percent, alpha globulin 7.9 percent, beta globulin 14.4 percent, and gamma globulin 11.2 percent. The mobilities of these components were found to be: albumin 5.60, alpha globulin 3.76, beta globulin 2.40, and gamma globulin 1.60, expressed in the order of 10^{-5} $cm.^2$ $sec.^{-1}$ $volt^{-1}$.

The Pectolytic Activity of Molds Isolated from Black Raspberries

WHITE, L. S., AND F. W. FABIAN

Applied Microbiology 1: 243-247. 1953 (Journal Article 1493 from the Michigan Agricultural Experiment Station)

The present study was concerned primarily with the pectolytic properties of molds which had been isolated from black raspberries. High mold counts, as determined by the Howard method, had been noted. Heavy suspensions of the molds were inoculated experimentally into mineral media containing citrus and apple pectins as the sole sources of carbon and into juice extracted from canned "water packed" black raspberries. It was found that the degree of enzymatic activity shown by the molds varied considerably according to the medium.

In black raspberry juice, *Alternaria* sp. failed to produce surface growth during a 10-day incubation period at 22°-25° C. In marked contrast to other molds examined, *Alternaria* sp. and *Cladosporium* sp. did not develop any evidence of pectolytic enzyme production. Molds which showed the greatest activity in black raspberry juice were *Penicillium* sp., *Pullularia* sp., and *Fusarium* sp.

In the mineral medium, *Fusarium* sp. and *Alternaria* sp. produced the greatest pectolytic activity of all cultures tested. *Botrytis* sp. contained in black raspberry juice (pH 3.8) and grown in a medium containing apple pectin (pH 6.3), produced an increase in the viscosity of test pectin similar to that commonly shown by pectin-methylesterase. In a medium containing citrus pectin (pH 5.4) a decrease in the viscosity of the test pectin solutions was observed. Weaknesses of the Howard mold count method were considered, particularly as these weaknesses concern the evaluation of the sanitary and structural condition of black raspberries.

The Effect of Bacteria on the Color of Prepackaged Retail Beef Cuts

BUTLER, O. D.; L. J. BRATZLER AND W. L. MALLMANN

Food Tech. 7: 397-400. 1953 (Journal Article 1502 from the Michigan Agricultural Experiment Station)

The effect of bacteria on the color of prepackaged fresh retail beef cuts was studied. Boneless beef steaks were cut, treated and displayed in a self-service meat display case under varying conditions. Meat color was measured objectively by disk colorimetry and percentage of metmyoglobin. It was found that bacteria found on meat cuts caused discoloration. The main effect was the increase in metmyoglobin formation. Desirable color was maintained longer at 34° F. than at 40° F. in a self-service case. A temperature of 32° F. was more effective than a rack level temperature of 34° F. in the self-service case.

The Influence of Vinegar Eels *(Anguillula aceti)* on Vinegar Production

ZALKAN, R. C., AND F. W. FABIAN

Food Tech. 7: 453-455. 1953 (Journal Article 1506 from the Michigan Agricultural Experiment Station)

A study was made of the influence of vinegar eels upon acetic acid production by *Acetobacter aceti* in a battery of six industrial pilot-plant glass vinegar generators. Tests were run with and without vinegar eels in the presence of various concentrations of K, P, and N inorganic salts, using fermented cider and dilute solutions of industrial 35-A alcohol.

The presence of vinegar eels in the quick-vinegar process was found to increase both the speed of acetification and the efficiency of the conversion of alcohol to acetic acid. These findings are not in agreement with observations reported by other workers.

The mechanism by which the vinegar eels favorably affect the process has not yet been made clear. It may be that they serve a dual purpose. First, they act as scavengers, keeping the beechwood shavings free of dead vinegar bacteria, thus permitting live and active acetic bacteria to grow and, thereby, increase acetification; second, the vinegar eels depend on the bacterial cells in the generators as a source of food and convert some of the nutrient salts in the circulating medium to compounds more readily available to the vinegar bacteria. Thus, there may be a symbiotic relationship established between the eels and the bacteria that is mutually beneficial.

Influence of Gram-Negative Bacteria on the Sauerkraut Fermentation

FULDE, R. C., AND F. W. FABIAN

Food Tech. 7: 486-489. 1953 (Journal Article 1516 from the Michigan Agricultural Experiment Station)

Aerobacter cloacae and *Flavobacterium rhenanus* were identified as members of the Gram-negative group that were found to increase in numbers during the beginning stages of the normal sauerkraut fermentation. *A. cloacae* was the more prevalent of the two inasmuch as it was isolated in five out of the six fermentations. The measurement of the oxidation-reduction potentials during the normal

fermentation showed that the Eh decreases with the growth of the Gram-negative bacteria. When a large inoculum of *A. cloacae* was placed in sterile cabbage juice with an inoculum of *Leuconostoc mesenteroides* or other acid-forming bacteria, the formation of acid was retarded. With a smaller inoculum, *A. cloacae* apparently produces favorable conditions for the growth of *L. mesenteroides*, as indicated by a greater acid formation in the mixed culture.

The introduction of large numbers of *A. cloacae* into the natural sauerkraut fermentation showed that this organism was capable of causing dark sauerkraut and at the end of 2 weeks produced a sharp radish-like flavor which was undesirable. The exposure of such sauerkraut to the air intensified darkening.

Role of Thyroid Hormone in Reproductive Physiology of the Female

REINEKE, E. P., AND FOUAD A. SOLIMAN

Iowa State College Jour. of Sci. 28: 67-82. 1953 (Journal Article 1523 from the Michigan Agricultural Experiment Station)

The experiments reported show that the thyroid function of the rat and the mouse undergoes rhythmic variations that are closely correlated with the stage of the estrus cycle. Both the basal oxygen consumption and the collection of radioactive iodine by the thyroid of the female rat show a significant increase during estrus. In mice the uptake of iodine by the thyroid is maximal at proestrus. Further experiments in ovariectomized rats indicate that this increase in thyroid activity at estrus is mediated by estrogenic hormone from the Graafian follicle of the ovary. The decrease in thyroid function following this peak is brought about by progesterone. Experiments on ovariectomized-hypothysectomized rats show that estrogen exerts its action on the thyroid indirectly by way of the pituitary gland. Progesterone apparently acts through some other pathway. These results, together with information previously available, indicate that there is a reciprocal balance between the hormones of the pituitary, ovary and thyroid. Through the influence of estrogen on pituitary thyrotropin the thyroid undergoes rhythmic fluctuations in secretion rate that in turn regulate the output of gonadotrophins and also modify their action on the ovary. A rhythmic sequence of changes apparently occurs in this balance during follicular growth, estrus and ovulation. An imbalance in this hormonal mechanism will not necessarily result in complete reproductive failure, but usually leads to great irregularity.

Relation of Nutrition to Endocrine-Reproductive Functions

MEITES, JOSEPH

Iowa State College Jour. of Sci. 28: 19-44. 1953 (Journal Article 1530 from the Michigan Agricultural Experiment Station)

Few nutritional factors have thus far been shown to influence conclusively reproductive functions. These include undernutrition or any condition which produces loss of appetite, including deficiencies of B-vitamins, and lack of vitamins A, E, or folic acid. Factors which have not yet definitely been shown to be essential include unsaturated fatty acids and proteins. The only type of malnutrition which has conclusively been proven to impair the secretion of gonadotropic hormones by the pituitary is underfeeding or any state leading to inanition, including inadequacies of B-vitamins.

Microbiological Studies of Cucumber Fermentations

COSTILOW, R. N., AND F. W. FABIAN

Applied Microbiology 1: 314-319. 1953 (Journal Article 1535 from the Michigan Agricultural Experiment Station)

Acid-forming bacteria and yeasts were the two groups of microorganisms found to be active in 13 cucumber fermentations studied. Ten of the fermentations were under commercial conditions, and three were in the laboratory. The acid-forming bacteria started rapid growth in cucumber brines within 24 hours after salting, attained their peak populations in from 3 to 5 days, declined rapidly for about the next 5 days, and continued to decline at a slower rate for the remainder of the period investigated (over 50 days). Sixteen of twenty isolates of acid-forming bacteria were identified as *Lactobacillus plantarum.* The other four were cocci but were not completely identified. Yeast populations in commercial cucumber fermentations declined for the first 3 to 5 days before initiating rapid growth. Peak populations of yeasts occurred in from 10 to 20 days after brining and declined thereafter. The principal yeasts found were *Torulopsis holmii* and *Torulaspora rosei. Brettanomyces versatilis* and *Hansenula subpelliculosa* were also found to be present.

Availability of Essential Vitamins and Amino Acids for *Lactobacillus plantarum* in Cucumber Fermentations

COSTILOW, R. N., AND F. W. FABIAN

Applied Microbiology 1: 320-326. 1953 (Journal Article 1537 from the Michigan Agricultural Experiment Station)

Microbiological assays for three vitamins and six amino acids essential for *Lactobacillus plantarum* were run on brines from six cucumber fermentations under commercial conditions and from three laboratory fermentations. Assays were also run on brines covering three different sizes of cucumbers which were not permitted to ferment. Biotin, niacin and pantothenic acid were found to diffuse rapidly from the cucumbers and reached a maximum concentration in the brine in from 5 to 10 days. Leucine, isoleucine, valine, glutamic acid, tryptophane and cystine were much slower than the vitamins in reaching their maximum concentration in the brines. However, in virtually all instances they were present in sufficient concentrations within 24 hours to support the growth of *L. plantarum.* Brines covering smaller cucumbers were found to be richer in all nutrients studied than were those which covered the larger sizes. Tryptophane was the only nutrient studied which was consistently affected by the fermentation. Marked reductions in tryptophane concentrations occurred when yeast activity was greatest.

Effect of Various Microorganisms on the Vitamin and Amino Acid Content of Cucumber Brines

COSTILOW, R. N., AND F. W. FABIAN

Applied Microbiology 1: 327-329. 1953 (Journal Article 1538 from the Michigan Agricultural Experiment Station)

Two species of bacteria (*Lactobacillus plantarum* and a coliform isolate) and four species of yeasts (*Torulopsis holmii, Torulaspora rosei, Torulopsis caroliniana* and *Hansenula subpelliculosa*) were tested for their influence on the concentrations of three vitamins and six amino acids in cucumber brines. The biotin content of the brines was markedly decreased by all six of the microorganisms tested and pantothenic acid by *L. plantarum*. No measurable effect was noted with niacin. *L. plantarum* and the four yeasts reduced the levels of leucine, isoleucine, valine and tryptophane, and the coliform isolate greatly reduced the concentrations of glutamic acid and cystine in the brine. Some increases in the glutamic acid and cystine content of the brine were noted with some of the yeasts.

The Use of Long-Run Price Forecasts in Farm Planning

NIELSON, JAMES

Jour. of Farm Econ. 35: 1000-1007. 1953 (Journal Article 1539 from the Michigan Agricultural Experiment Station)

In deciding upon a basic farm plan to be followed during the period 5 to 10 years in the future, farmers must formulate some expectations regarding the prices which will prevail for the products which they will be selling and the costs of the items which they will be purchasing. Making estimates or forecasts of prices in the period ahead, after considering the relevant economic factors, will provide a better basis for planning than using present prices or prices from some so-called typical past period. To assist farmers in formulating their long-run price expectations, the writer has forecast a set of agricultural prices and costs for 1960. Several of the more important assumptions made for the period 1952-60 are: 1) no all-out war, no real peace, and a high rate of defense spending will continue; 2) an average annual federal government deficit of $5 billion; 3) a continuation of the present high birth rate, and 4) an approximate 1½ percent increase in agricultural production each year. The analysis indicates a 7-percent increase in prices received by Michigan farmers over 1952 levels, and an 8.5-percent increase in prices paid. When translated into prices for individual commodities, the projections call for decreases in the prices of cattle, little changes or slight increases in the prices of sheep, poultry, eggs, and most grains; and relatively larger increases for hogs and poultry.

Effects of Cortisone on Thiamine-Deficient Young Rats

WILWERTH, A. M., AND J. MEITES

Proc. Soc. for Expt. Biol. and Med. 83: 872-875. 1953 (Journal Article 1541 from the Michigan Agricultural Experiment Station)

1) A total of 128 young male albino rats were used in two experiments to determine the effects of large doses of cortisone on thiamine requirements. For

preliminary periods of either 10 or 18 days, they were fed a semi-synthetic ration from which thiamine was omitted. This was followed by injections of 1 mg. of cortisone daily with or without several levels of thiamine for another 12 or 18 days.

2) Pre-existent deficiency symptoms were aggravated by cortisone, resulting in decreased body growth and survival rate, priapism, cannibalism and loss of muscular coordination. The rats which were initially deficient in thiamine for the longer period, showed the most severe reactions to cortisone administration. Cortisone decreased the efficiency of converting food into body weight gains in all cases.

3) When 1 mg. of thiamine per kilo of ration was fed, representing normal requirements for growing rats, there was little or no increase in body weight although most deficiency symptoms disappeared. When 5, 10 or 20 mg. of thiamine per kilo of ration were fed, each level was equally effective in counteracting growth inhibition by cortisone.

Differential Inactivation of Prolactin by Mammary Tissue from Pregnant and Parturient Rats

SCOURIS, J. T., AND J. MEITES

Am. Jour. of Physiol. 175: 319-321. 1953 (Journal Article 1543 from the Michigan Agricultural Experiment Station)

The inguinal mammary glands were removed from 17 rats on the 12-15th days of gestation and from 19 rats on the 4th day postpartum. The glands were homogenized and 100-mg. samples were incubated with 0.2 mg. of Squibb prolactin (20-25 IU/mg.) at 38 $\pm$ 0.1° C. for 1 hour. For controls, the same amount of prolactin was similarly incubated without mammary tissue or with boiled mammary tissue. After incubation, the tissues were removed and assayed in White Carneau pigeons for prolactin activity. The mammary homogenate from the lactating rats inactivated 65.6 percent of the prolactin, as compared with 19.5 percent for the tissue from the pregnant rats. When corrected for milk content, by lactose determinations, the former tissue showed eight times as much capacity to remove prolactin as did the latter. These data suggest that the mammary glands of pregnant rats cannot utilize prolactin to any marked extent, and that this contributes to the absence of copious lactation during gestation.

Agricultural Policy and Farmers' Freedom: A Suggested Framework

HATHAWAY, DALE E.

Jour. of Farm Econ. 35: 496-510. 1953 (Journal Article 1557 from the Michigan Agricultural Experiment Station)

This article suggests that the current theories of social value are inadequate to explain farmers' attitudes toward freedom in agricultural policy. A different theoretical framework to explain the actions of farm groups during periods of changing prices is advanced.

It is suggested that farmers have differing marginal rates of substitution between freedom, real income, equity, and efficiency as their income possibilities from the unsupported markets change. Thus, at one time farmers are very opposed

to production controls in order to get higher prices; yet, at another time they vote overwhelmingly to accept these production controls. This framework is used to explain the recent farmer vote on marketing quotas for wheat.

A Study of Corynebacterium Renale-like Organisms Isolated from Cows

BISWAL, GANESWAR; M. L. GRAY AND FRANK THORP, JR.

M.S.C. Vet. 14: 19-24, 33. 1953 (Journal Article 1568 from the Michigan Agricultural Experiment Station)

A study was made of 10 cultures of *Corynebacterium renale*-like organisms isolated from cows suffering from pyelonephritis. These organisms were similar in most respects to *C. renale* on the basis of ecology, morphology, cultural characteristics and pathogenicity for mice and rabbits. However, they grew more slowly and in certain other characteristics differed sufficiently from typical *C. renale* that they were designated *C. renale*-like. Mice exposed intravenously developed lesions, ranging from mild congestion to a chronic type of pyelonephritis. Necrosis and amyloidosis in the liver, proliferation of lymphocytes beyond the splenic corpuscles, increased number of giant cells in the red pulp of the spleen, and interstitial pneumonitis and bronchitis also were seen. Intravenous exposure of rabbits produced a definite drop in hemoglobin, an increase in heterophile and a decrease in lymphocyte counts. Lesions were similar to those in mice but also included cystitis and ureteritis. The capacity to produce pyelonephritis in mice and rabbits was similar to that of *C. renale*, and the lesions resembled those found in pyelonephritis in cattle. The study suggested that under certain conditions, these organisms might be responsible for bovine pyelonephritis.

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